OPERATING AND SERVICE MANUAL

5006A
SIGNATURE ANALYZER

SERIAL PREFIX: 2314A

This manual applies to Serial Prefix 2314A, unless accompanied by a Manual Change Sheet indicating otherwise.

©Copyright HEWLETT-PACKARD COMPANY 1985
5301 Stevens Creek Boulevard, Santa Clara, California 95051

MANUAL PART NUMBER 05006-90010
MICROFICHE PART NUMBER 05006-90011

PRINTED: NOVEMBER 1985

HEWLETT PACKARD

TABLE OF CONTENTS

Section	Title	Page
I	**GENERAL INFORMATION**	1-1
	1-1. Introduction	1-1
	1-3. Manual Summary	1-1
	1-5. Specifications	1-1
	1-7. Description	1-1
	1-9. Accessories Supplied	1-1
	1-11. Instrument and Manual Identification	1-1
	1-16. Safety Considerations	1-3
	1-18. Safety Symbols	1-3
	1-20. Recommended Test Equipment	1-4
II	**INSTALLATION**	2-1
	2-1. Introduction	2-1
	2-3. Unpacking and Inspection	2-1
	2-5. Preparation for Use	2-1
	2-6. Power Requirements	2-1
	2-8. Line Voltage Selection	2-1
	2-10. Selection of the Line Fuse	2-1
	2-12. Power Cable	2-1
	2-14. HP-IB Interconnections (Option 040)	2-2
	2-16. Cable Length Restrictions	2-2
	2-18. HP-IB Talk/Listen Address Switch	2-3
	2-20. HP-IB Description	2-3
	2-22. HP-IL Interconnections (Option 030)	2-4
	2-24. HP-IL Description	2-4
	2-26. Operating Environment	2-4
	2-30. Storage and Shipment	2-4
	2-31. Environment	2-4
	2-34. Packaging	2-4
III	**OPERATION AND PROGRAMMING**	3-1
	3-1. Introduction	3-1
	3-3. Operating Characteristics	3-1
	3-10. Operating Instructions	3-1
	3-14. Signature Analysis	3-2
	3-19. Signature Analysis Literature	3-2
	3-21. Data Probe and Timing Pod Holder	3-2
	3-23. Test Terminal Grabber Connections	3-2
	3-25. Typical Connections of 5006A to Device Under Test	3-3
	3-27. Panel Features	3-3
	3-29. Operator's Maintenance	3-3
	3-31. Power-Up Self-Check	3-3
	3-34. Error and Failure Messages	3-4
	3-39. General Operation Information	3-5
	3-40. Introduction	3-5
	3-42. Power-Up Default States	3-5
	3-45. Operation of the GATE LED	3-5
	3-47. Operation of the COMPOSITE SIGNATURE LED	3-5
	3-49. Operation of the UNSTABLE LED	3-5
	3-51. Operation of the Data Probe Tip LED	3-5
	3-54. Operation of the Data Probe Switch	3-5

TABLE OF CONTENTS (Continued)

Section	Title	Page
III	**OPERATING AND PROGRAMMING (Continued)**	
	3-60. The 5006A Signature Memory	3-6
	3-63. The 5006A Composite Signature	3-7
	3-68. Selecting FUNCTIONS	3-8
	3-77. 5006A POLARITY Selections	3-9
	3-78. Trigger Thresholds	3-9
	3-83. Selecting CMOS Input Logic Thresholds	3-10
	3-85. Making Signature Analysis Measurements	3-10
	3-88. Signature Analysis Measurements (Normal)	3-10
	3-91. Signature Analysis Measurements (Qualified)	3-10
	3-94. Basic Measurement Procedure	3-11
	3-96. Remote Programming	3-18
	3-97. Introduction	3-18
	3-102. Interface Description	3-18
	3-103. Hewlett-Packard Interface Bus (HP-IB)	3-18
	3-105. Hewlett-Packard Interface Loop (HP-IL)	3-18
	3-108. Interface Functional Overview	3-18
	3-112. Interface System Terms	3-19
	3-114. Address Selection	3-19
	3-118. Front Panel Interface Status LEDs	3-21
	3-121. Interface Function	3-21
	3-125. Interface Commands	3-22
	3-128. Interface Capabilities	3-23
	3-131. Device Independent Commands	3-23
	3-134. Meta Messages	3-25
	3-139. SRQ, SRQ Mask, and Status Byte	3-27
	3-144. Device Dependent Commands	3-28
	3-145. Input Format	3-28
	3-147. Command Descriptions	3-28
	3-151. Function Commands	3-28
	3-152. Polarity Commands	3-28
	3-153. Sends Data Commands	3-28
	3-154. Measurement Triggering in Remote (Default Mode)	3-28
	3-156. Command Descriptions	3-29
	3-158. Receive Data Commands	3-30
	3-160. Other Device Dependent Commands	3-31
	3-162. Programming Examples	3-33
IV	**PERFORMANCE TESTS**	4-1
	4-1. Introduction	4-1
	4-3. Equipment Required	4-1
	4-5. Calibration Cycle	4-1
	4-7. Test Record	4-1
	4-9. Operation Verification Tests	4-1
	4-12. Self-Test Verification	4-1
	4-14. Interface Verification	4-2
	4-22. Performance Tests	4-9

TABLE OF CONTENTS (Continued)

Section	Title	Page
V	**ADJUSTMENTS**	5-1
	5-1. Introduction	5-1
	5-4. Safety Considerations	5-1
	5-8. Equipment Required	5-1
	5-10. Adjustments Procedure	5-1
VI	**REPLACEABLE PARTS**	6-1
	6-1. Introduction	6-1
	6-3. Abbreviations	6-1
	6-5. Replaceable Parts List	6-1
	6-9. Manufacturers Code List	6-1
	6-11. Ordering Information	6-1
	6-14. Direct Mail Order System	6-1
	6-17. Cabinet Parts and Hardware	6-2
VII	**MANUAL CHANGES**	7-1
	7-1. Introduction	7-1
	7-3. Manual Changes	7-1
	7-6. Older Instruments	7-1
VIII	**SERVICE**	8-1
	8-1. Introduction	8-1
	8-3. Theory of Operation	8-1
	8-5. Troubleshooting	8-1
	8-8. Recommended Test Equipment	8-1
	8-15. Schematic Diagram Notes and Reference Designators	8-1
	8-17. HP 5006A Assembly and Cable Designations	8-3
	8-20. Identification Marks on Printed Circuit Boards	8-3
	8-25. Safety Considerations	8-3
	8-30. Service Aids	8-4
	8-31. Service Aids on Printed Circuit Boards	8-4
	8-33. Diagnostic Routines	8-4
	8-35. Logic Symbols	8-5
	8-37. Logic Concepts	8-5
	8-39. Negation	8-5
	8-41. Logic Implemenation and Polarity Indication	8-6
	8-52. Dependency Notation "C" "G" "V" "F"	8-8
	8-54. Control Blocks	8-8
	8-56. Repair Techniques	8-9
	8-57. Disassembly and Reassembly	8-9
	8-61. Main Cabinet Disassembly	8-9
	8-62. Disassembly of Interface, Front Panel, and Rear Panel	8-10
	8-63. Data Probe Disassembly	8-10
	8-64. Timing Pod Disassembly	8-10
	8-65. Instrument Reassembly	8-10
	8-67. 5006A Theory of Operation	8-11
	8-68. Introduction	8-11
	8-71. Block Level Description	8-11
	8-79. Detailed Circuit Theory	8-13
	8-81. Stage Name: Power Supply	8-13
	8-82. Circuit Description	8-13

TABLE OF CONTENTS (Continued)

Section	Title	Page
VIII	**SERVICE (Continued)**	
	8-90. Stage Name: Input Voltage Comparators and Level Translators	8-16
	8-91. Circuit Description	8-16
	8-96. Stage Name: Edge Select and Qualify Enable	8-17
	8-97. Circuit Description	8-17
	8-103. Stage Name: Gate Control	8-18
	8-104. Circuit Description	8-18
	8-108. Stage Name: Gate Handshake	8-18
	8-109. Circuit Description	8-18
	8-115. Stage Name: Data Sample/Logic Probe Latches	8-19
	8-116. Circuit Description	8-19
	8-120. Stage Name: Feedback Shift Register (FSR)	8-20
	8-121. Circuit Description	8-20
	8-126. Stage Name: Central Control Unit, Keyboard Matrix, and Display Driver	8-20
	8-127. Circuit Description	8-20
	8-133. Stage Name: Remote Interface/I/O Port	8-21
	8-134. Circuit Description	8-21
	8-138. Stage Name: Data Probe/Timing Pod	8-21
	8-139. Circuit Description	8-22
	8-142. Troubleshooting	8-22
	8-143. Introduction	8-22
	8-145. Troubleshooting Flowchart	8-22
	8-147. Built-In Troubleshooting Aids	8-22
	8-149. Troubleshooting Procedure	8-22

LIST OF TABLES

Table	Title	Page
1-1.	5006A Specifications	1-2
1-2.	Recommended Test Equipment	1-4
2-1.	HP-IB Cable Descriptions	2-2
3-1.	Error and Failure Messages	3-4
3-2.	Power-Up Default States	3-5
3-3.	Probe Switch Functions	3-6
3-4.	Preset Trigger Thresholds	3-9
3-5.	Address Selection	3-20
3-6.	Interface Functions	3-21
3-7.	5006A Interface Capabilities	3-23
3-8.	5006A Device Independent Commands	3-24
3-9.	Meta Messages	3-26
3-10.	Meta Messages and Controller Commands	3-27
3-11.	HP 5006A Status Byte	3-27
3-12.	Instrument Program Command Set	3-32

LIST OF TABLES (Continued)

Table	Title	Page
4-1.	Interface Operation Verification Program Listing	4-4
4-2.	Operation Verification Test Record	4-17
4-3.	Performance Tet Record	4-17
6-1.	Reference Designations and Abbreviations	6-3
6-2.	Replaceable Parts List	6-10
6-3.	Manufacturers Code List	6-18
7-1.	Manual Backdating	7-1
8-1.	Assembly Designations	8-3
8-2.	Safety Symbols Used on HP Equipment	8-4
8-3.	Error and Failure Message Response During Troubleshooting	8-40

LIST OF FIGURES

Figure	Title	Page
1-1.	Model 5006A Signature Analyzer and Power Cable	1-0
2-1.	Line Voltage Selection	2-1
2-2.	Power Cable HP Part Numbers versus Mains Plugs Available	2-2
2-3.	Hewlett-Packard Interface Bus Connections	2-3
2-4.	Typical HP-IL Interface Connection	2-4
3-1.	Data Probe and Timing Pod Holder	3-2
3-2.	Test Terminal Grabber Connections	3-3
3-3.	Typical Connections of 5006A to Device Under Test	3-3
3-4.	Signature Memory	3-7
3-5.	Composite Signature Display	3-7
3-6.	Front Panel FUNCTION Keys	3-8
3-7.	Front Panel POLARITY Keys	3-9
3-8.	Signature Analysis Measurement Timing	3-10
3-9.	Signature Analyzer, Data Probe, Time Pod Features	3-12
3-10.	Front Panel Indicators	3-13
3-11.	Front Panel Controls	3-15
3-12.	Rear Panel Features	3-17
3-13.	5006A Address Switches	3-19
3-14.	Typical HP-IL System Addressing	3-21
4-1.	Self-Test Verification Setup	4-1
4-2.	HP-IB Operation Verification Setup	4-2
4-3.	Data Probe Test Setup	4-11
4-4.	Data Probe Setup Time - Test 1	4-12

LIST OF FIGURES (Continued)

Figure	Title	Page
4-5.	Data Probe Setup Time - Test 2	4-12
4-6.	Data Probe Setup Time - Test 3	4-13
4-7.	Data Probe Setup Time - Test 4	4-13
4-8.	Data Hold Time - Test 1	4-14
4-9.	Data Hold Time - Test 2	4-14
4-10.	Data Hold Time - Test 3	4-15
4-11.	Data Hold Time - Test 4	4-15
5-1.	Data Probe Input Compensation Adjustment Location	5-2
5-2.	Input Compensation Adjustment Setup	5-3
5-3.	Pulse Generator Output	5-4
5-4.	Overcompensated	5-4
5-5.	Proper Compensation (Intermittent)	5-5
5-6.	Proper Compensation (Stable)	5-5
6-1.	Cabinet Parts and Hardware	6-4
6-2.	Cabinet Parts and Hardware (Data Probe)	6-6
6-3.	Cabinet Parts and Hardware (Timing Pod)	6-8
8-1.	Schematic Diagram Notes	8-2
8-2.	Main Cabinet Disassembly	8-9
8-3.	Rear Panel Disassembly	8-10
8-4.	Data Probe Disassembly	8-10
8-5.	Timing Pod Disassembly	8-11
8-6.	5006A Block Diagram	8-13
8-7.	Unregulated Power Supply Ripple	8-14
8-8.	Switching Power Supply Output	8-15
8-9.	Overall Troubleshooting Tree	8-23
8-10.	Troubleshooting Flowchart A	8-25
8-11.	Troubleshooting Flowchart B	8-27
8-12.	Troubleshooting Flowchart B1 (F-30)	8-28
8-13.	Troubleshooting Flowchart B1 (F-31)	8-29
8-14.	Troubleshooting Flowchart B2	8-30
8-15.	Troubleshooting Flowchart B3	8-31
8-16.	Troubleshooting Flowchart Clock Check	8-32
8-17.	Troubleshooting Flowchart B4	8-33
8-18.	Troubleshooting Flowchart B5	8-34
8-19.	Troubleshooting Flowchart B6 and B7	8-35
8-20.	Troubleshooting Flowchart B8	8-36
8-21.	Troubleshooting Flowchart Next 1	8-37
8-22.	Signature Table	8-38
8-23.	5006A Simplified Block Diagram	8-41
8-24.	A1 Main Assembly Schematic Diagram	8-43
8-25.	A2 Display Assembly Schematic Diagram	8-45
8-26.	A3 Data Probe Assemby and A6 Pod Timing Assembly Schematic Diagram	8-47
8-27.	A4 HP-IL Option 030 Assembly Schematic Diagram	8-49
8-28.	A5 HP-IB Option 040 Assembly Schematic Diagram	8-51

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINAL OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE EARTH (GROUNDING) CONDUCTOR.

WARNING

THE GROUND TEST LEADS ON THE POD AND DATA PROBE ARE TIED TO THE CHASSIS GROUND OF THE INSTRUMENT AND SHOULD NOT BE CONNECTED TO A VOLTAGE OTHER THAN GROUND FOR MEASUREMENTS.

WARNING

ONLY FUSES WITH THE REQUIRED RATED CURRENT AND SPECIFIED TYPE SHOULD BE USED. DO NOT USE REPAIRED FUSES OR SHORT-CIRCUITED FUSE-HOLDERS. TO DO SO COULD CAUSE A SHOCK OR FIRE HAZARD.

WARNING

WHENEVER IT IS LIKELY THAT THE PROTECTION HAS BEEN IMPAIRED, THE INSTRUMENT MUST BE MADE INOPERATIVE AND BE SECURED AGAINST ANY UNINTENDED OPERATION.

WARNING

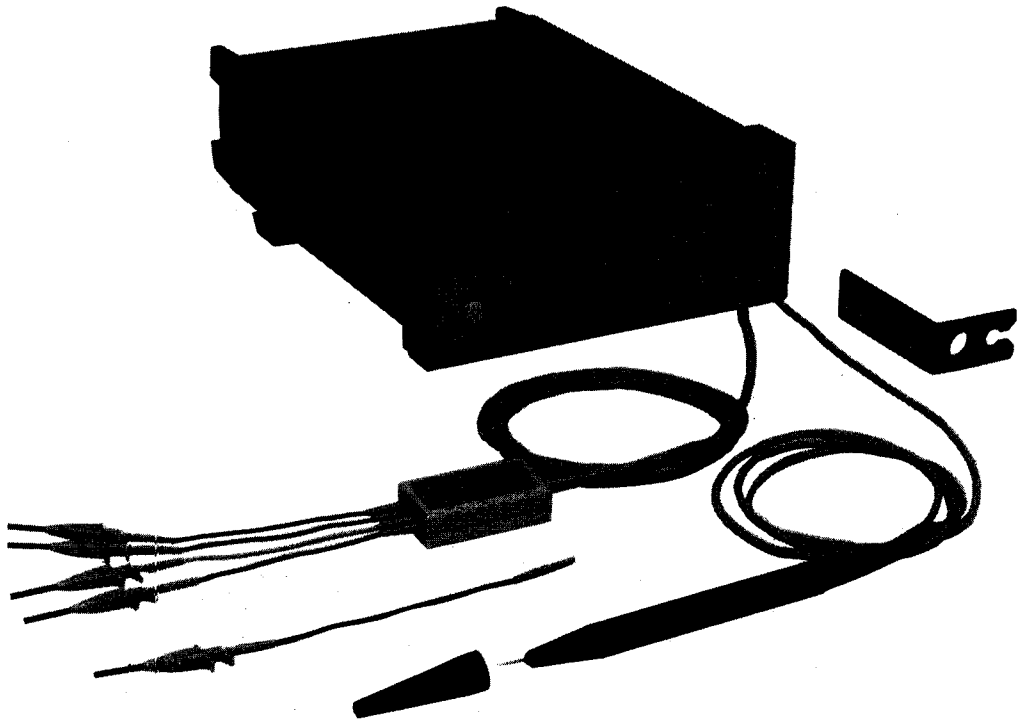
ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTOTRANSFORMERS, AND DEVICES CONNECTED TO THIS INSTRUMENT SHOULD BE CONNECTED TO A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. ANY INTERRUPTION OF THE PROTECTION WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY.

WARNING

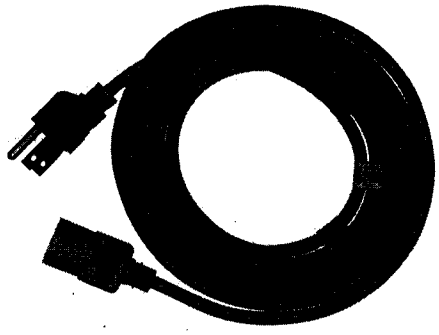
IF THE INSTRUMENT IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER FOR VOLTAGE REDUCTION, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE AC POWER SOURCE.

WARNING

ANY MAINTENANCE OR SERVICE REQUIRING REMOVAL OF PROTECTIVE COVERS SHOULD BE PERFORMED BY SERVICE-TRAINED PERSONS WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK).



5006A SIGNATURE ANALYZER AND EQUIPMENT SUPPLIED



POWER CORD
PART NO. 8120-1378

Figure 1-1. Model 5006A Signature Analyzer and Power Cable

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains the information necessary to install, operate, and program the Hewlett-Packard Model 5006A Signature Analyzer. The Signature Analyzer with its supplied accessories is shown in *Figure 1-1.*

1-3. MANUAL SUMMARY

1-4. This manual is divided into eight sections, each covering a particular topic of the operation and programming of the HP5006A. The topics by section number are:

SECTION I, GENERAL INFORMATION. Provides the instrument specifications, instrument identification, accessories and recommended test equipment.

SECTION II, INSTALLATION. Provides information about initial inspection, preparation for use, storage, and shipment.

SECTION III, OPERATION. Provides information about operating characteristics, front and rear panel features, Operator's Check, operating instructions, measurement procedures, and programming. Remote programming information for both HP-IB and HP-IL are provided.

SECTION IV, PERFORMANCE TESTS. Provides abbreviated procedures for operation verification, which give the operator a high degree of confidence that the 5006A is operating properly. Also provides expansive performance test procedures which test the electrical performance of the 5006A, using the specifications in *Table 1-1* as standards.

SECTION V, ADJUSTMENTS. Provides the procedures and adjustment locations required to properly maintain the instrument operating characteristics within specifications.

SECTION VI, REPLACEABLE PARTS. Provides ordering information for all replaceable parts and assemblies within the instrument.

SECTION VII, MANUAL CHANGES. This section is reserved for manual change information which effectively "backdates" the technical areas of the manual to apply to older instruments.

SECTION VIII, SERVICE. This section provides the instrument theory of operation, troubleshooting information, repair techniques, and schematic diagrams.

1-5. SPECIFICATIONS

1-6. The specifications for the 5006A are listed in *Table 1-1.* These specifications are the performance standards or limits against which the 5006A can be tested.

1-7. DESCRIPTION

1-8. The 5006A is a test instrument for troubleshooting complex electronic logic circuits to the component level. The 5006A uses the signature analysis (SA) techniques of troubleshooting. Typically, a logic product designed for signature analysis troubleshooting will have a programmed controller and a stored or externally-provided test program which can exercise most of the circuitry.

1-9. ACCESSORIES SUPPLIED

1-10. The accessories supplied with the 5006A are shown in *Figure 1-1.* Their description and part number are given below:

a. Depending on the customer's country, the line power cable supplied has one of six appropriate line (mains) connectors. Refer to *Figure 2-2,* for the part number of the correct cable.

b. Five detachable "grabber" test connectors are supplied with the 5006A. Their part number is 10230-62101. Refer to Section III for description and use.

c. One ground lead for the data probe is supplied with the 5006A. Its part number is 05005-60116.

d. One data probe tip cover is supplied. Its part number is 00547-40005.

e. One Data Probe and Timing Pod holder is supplied. Its part number is 05006-00006.

1-11. INSTRUMENT AND MANUAL IDENTIFICATION

1-12. The instrument serial number is located to the right of the Line Input connector on the rear panel. The serial number is in the form; 0000A00000. The first four digits and the letter are the serial prefix. The last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The

Table 1-1. 5006A Specifications

GENERAL

Display: 4 digits. Characters 0-9, ACFHPU.

Fault detection accuracy: 100% probability of detecting single-bit errors; 99.998% probability of detecting multiple-bit errors.

Composite signature:
Maximum number of signatures: No limit. Sums all signatures, triggered by probe switch, following depression of CLEAR key, or power-up.

Signature memory:
Signatures recallable by probe switch: The last 32 signatures triggered by probe switch.

TIMING

Clock:
Maximum frequency: 25 MHz.
Minimum clock time: 15 nsec in high or low state.

Probe:
Setup time: 10 ns with 0.2V overdrive. (Data to be valid at least 10 ns before selected clock edge.)

Hold time: 0 ns. (Data to be held until occurrence of selected clock edge.)

Start, stop, qualifier:
Setup time: 20 ns with 0.2V overdrive. (Data to be valid at least 20 ns before selected clock edge.)

Hold time: 0 ns. (Data to be held until occurrence of selected clock edge.)

Minimum gate length: 1 clock cycle (1 data bit) between START and STOP.

Maximum gate length: No limit.

Minimum timing between gates: 1 clock cycle between STOP and START.

INPUT IMPEDANCE

Probe: 50kΩ to ground nominal.

Pod: 100kΩ to ground nominal.

CMOS sense: 700Ω nominal.

⚠ OVERLOAD PROTECTION

Probe:
±150V continuous.
±250V intermittent.
250V ac for 1 minute.

Pod:
±20V continuous.
±140V intermittent.
140V ac for 1 minute.

CMOS sense: 20V dc maximum.

TTL THRESHOLDS

Probe:
Logic one: 2 Volt + .2-.3
Logic zero: 0.8 Volt + .3-.2

Pod: 1.4 Volt ±.6

CMOS THRESHOLDS

Probe:
Logic one: 70% of sensed voltage nominal.
Logic zero: 30% of sensed voltage nominal.

Pod: 50% of sensed voltage nominal.

DISPLAY AND INDICATORS

Signature: Four seven-segment digits with decimal point.

Lamps:
Key status: Recall, edit, signature latch, unstable latch, qualify mode, timing polarities.

Programmable: Remote, talk, listen, SRQ. (Option 030 or 040.)

Status: Composite signature, gate, unstable.

Pulse stretching: 100 msec on gate and unstable lamps.

Probe:
Logic levels indicated: High, low, open and pulsing *with 100 msec stretching.*

Minimum pulse width: 10 nsec.

*Switch: Under normal operation, pushing probe switch enters signatures into memory. End of measurement is indicated by probe light. If SIG LATCH is pushed, signature display will change only when probe switch is pushed. Memory stack is rolled by the probe switch in RECALL mode. A signature in memory is over-written by a new one when the probe switch is pushed in EDIT mode. Composite signature is up-dated if memory is edited. Normally, when the 5006A is under computer control, all measured signatures are sent to the computer. Under special command, only triggered signatures are sent to the computer."**

OTHER

Selectable power:
115V +10%-25% ac line, 48-440 Hz.
230V +10%-15% ac line, 48-66 Hz.
25VA maximum.

Operating environment:
Temperature: 0-55°C.

Humidity: 95% RH at +40°C.

Altitude: 4600M (15,000 ft.)

Size: 89 mm high × 216 wide 279 mm deep. (3-1/2 in. × 8-1/2 in. × 11 in.)

Net weight: 2.4 kg (5.3 lbs)

Shipping weight: 4.1 kg (9 lbs)

*Specifications describe the instrument's warranted performance. Supplemental characteristics *(shown in italics)* are intended to provide information useful in applying the instrument, but are non-warranted performance parameters.

contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-13. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instruments.

1-14. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-15. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-16. SAFETY CONSIDERATIONS

1-17. The 5006A is a Safety Class 1 instrument provided with a protective earth terminal. This product has been designed and tested according to international safety requirements. Safety information pertinent to the operation and servicing of this instrument is included in appropriate sections of this manual.

1-18. Safety Symbols

Note

The symbol ⚠ (ATTENTION) which appears on the panel of the instrument indicates that the user should refer to the instruction manual before operating, in order to avoid possible damage to the instrument. Within the manual, information relating to the ATTENTION symbol will be identified with a ⚠ symbol in the margin.

1-19. The following safety symbols are used on equipment and in manuals:

⚠	Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.
↯	Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).
⏚ OR ⏚	Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.
⏚	Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with the symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.
⏥ OR ⊥	Frame and chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.
~	Alternating current (power line).
⎓	Direct current (power line).
≂	Alternating or direct current (power line).

WARNING The WARNING signal denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

1-20. RECOMMENDED TEST EQUIPMENT

1-21. Equipment required to maintain the 5006A is listed in *Table 1-2.* Other equipment can be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-2. Recommended Test Equipment

Equipment	Required Characteristics	Adjustments	Used For			Recommended HP Model
			Op. Verification	Performance Tests	Troubleshooting	
Signature Analyzer	HP Compatible Signatures				X	5006A
Digital Voltmeter	+.001% acc.				X	3445A
Pulse Generator	25 MHz Square Wave			X		8082A
Universal Counter	100 MHz +TI 1ns Resolution			X		5370B
2 Pulse Generators	100 MHz Rate <2 ns transition time			X		8007B
Oscilloscope	100 MHz BW	X			X	1740A
Oscilloscope	275 MHz BW			X		1725A
Logic Lab Breadboard				X		5035T
Microprocessor Lab			X*			5036A
Probe Set						5022A
Tuning Wand	Ceramic Wand	X				8710-0033
Controller	HP-IB or IEEE 488 Compatible		X			HP 85

**Any instrument with an HP compatible digital signature analysis capability can be substituted here.*

Note

FOR OPTION 030 (HP-IL INTERFACE) ONLY

For establishing HP-IL based digital troubleshooting stations, the use of the HP-41C or HP-41CV controllers is recommended.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, installation, and storage of the HP5006A Signature Analyzer.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the instrument for visible damage (scratches, dents, etc.). If the instrument is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The Hewlett-Packard Sales and Service Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE

CAUTION

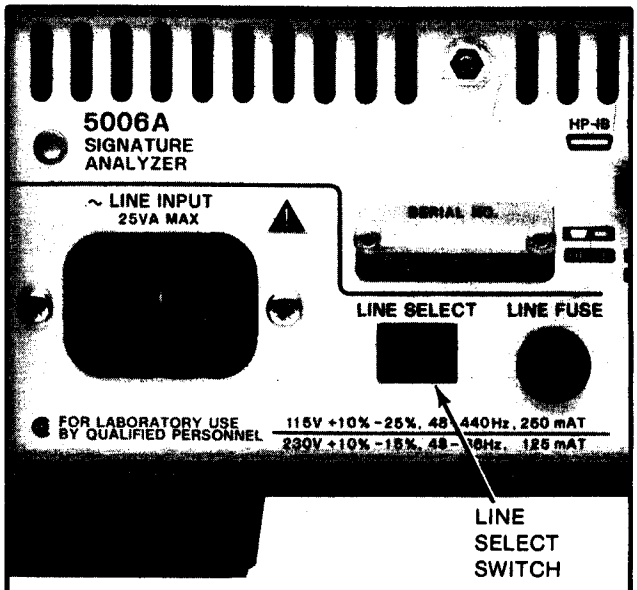
Before connecting the instrument to ac power lines, be sure that the correct fuse is installed and that the voltage selector is properly positioned as described below.

2-6. Power Requirements

2-7. The 5006A requires an ac line power source of 115V, +10%, -25%, 48 to 440 Hz single phase, or 230V, +10%, -15%, 48 to 66 Hz single phase.

2-8. Line Voltage Selection

⚠ 2-9. The power line voltage is selected by the position of the LINE SELECT switch on the rear panel. Sliding the switch to the left selects 115V operation, sliding the switch to the right selects 230V operation. The voltages available are printed on the switch. The specific voltage selected will be visible on the LINE SELECT switch, as shown in *Figure 2-1*. Before applying power, verify that LINE SELECT switch is properly set for the desired ac supply voltage and that the correct fuse is installed.



5006A REAR PANEL

SELECTION OF OPERATING VOLTAGE

1. For 115V operation, slide the LINE SELECT switch to the left until the label 115V is visible.
2. For 230V operation, slide the LINE SELECT switch to the right until the label 230V is visible.

Figure 2-1. Line Voltage Selection

2-10. Selection of the Line Fuse

2-11. The LINE FUSE is accessible from the rear panel. The 5006A will be shipped with the correct fuse for the country of destination installed, and the LINE SELECT switch set properly. To replace the line fuse use a small flat-bladed screwdriver to remove the fuse carrier from the fuseholder. Press in slightly and turn counter-clockwise, until the fuse carrier springs free. Replace the fuse in the fuse carrier and reinstall by reinserting and turning clockwise. Be sure to install the correct fuse value; 250 mAT/250V Slow Blow for 115V operation or 125 mAT/250V Slow Blow for 230V operation.

2-12. Power Cable

2-13. The 5006A is shipped with a three-wire power cable. When the cable is connected to an appropriate ac power source, this cable connects the instrument chassis to earth ground. The type of power cable plug shipped with each instrument depends on the country

of destination. Refer to *Figure 2-2* for the part numbers of the power cable and plug configurations available.

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINAL OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE EARTH (GROUNDING) CONDUCTOR.

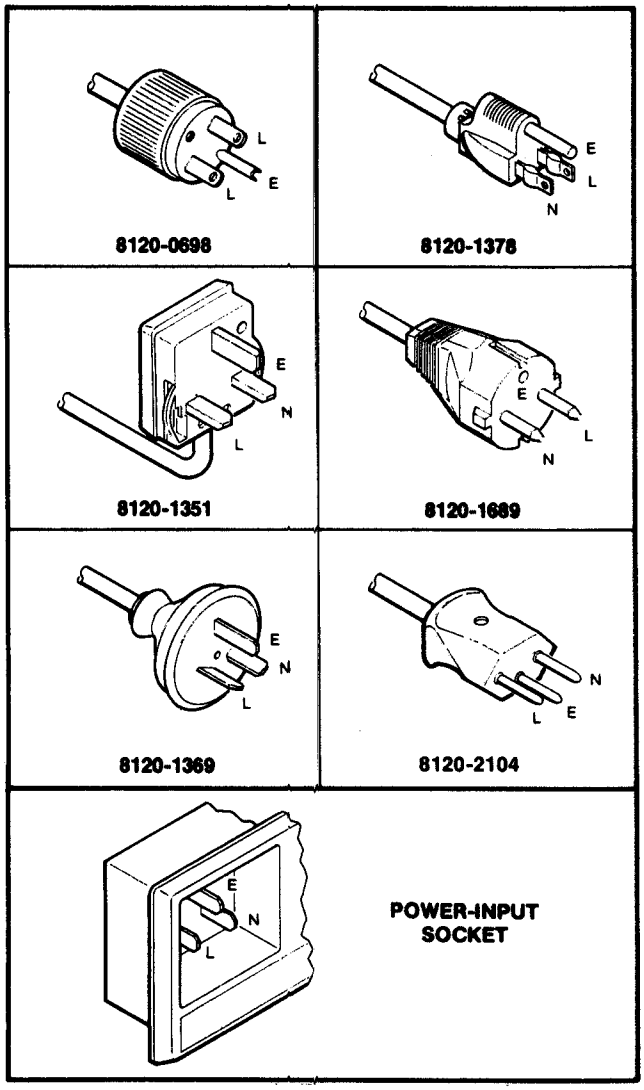


Figure 2-2. Power Cable HP Part Numbers versus Mains Plugs Available

2-14. HP-IB INTERCONNECTIONS (Option 040)

2-15. The 5006A with Option 040 is compatible with the Hewlett-Packard Interface Bus. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure 2-3*. This connector is compatible with the HP 10833A/B/C/D cables. (See *Table 2-1* for cable descriptions). The HP-IB system allows interconnection of up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggy-back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the controller to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces great leverage which can damage the connector mounting. Be sure each connector is firmly (finger tight) screwed in place to keep it from working loose during use.

Table 2-1. HP-IB Cable Descriptions

Model Number	Cable Length
10833A	1 metre (3.3 ft.)
10833B	2 metres (6.6 ft.)
10833C	4 metres (13.2 ft.)
10833D	0.5 metres (1.6 ft.)

The above symbol when located in the upper corner of a page indicates HP-IB information is contained on that page. This information may be operation, performance, adjustment, or service related.

2-16. Cable Length Restrictions

2-17. To achieve design performance with the HP-IB, the proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly, and the system will fail to perform properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules.

a. The total cable length for the system must be less than or equal to 20 metres (65 feet).

b. The total cable length for the system must be less than or equal to 2 metres (6.6 feet) times the total number of devices connected to the bus.

c. The total number of instruments connected to the bus must not exceed 15.

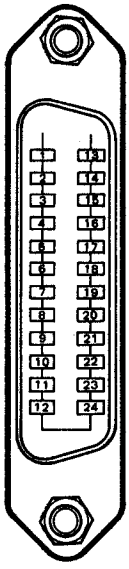
2-18. HP-IB Talk/Listen Address Switch

2-19. The 5006A provides a rear panel HP-IB instrument address selection switch. This switch determines the mode of remote operation as "Talk Only" or "addressable", and selects the HP-IB address. Instructions for changing the address are provided in Section III of this manual.

2-20. HP-IB Description

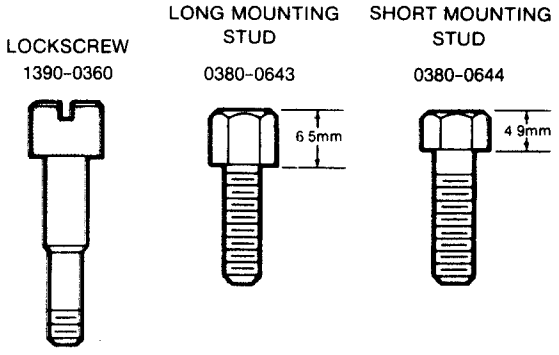
2-21. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if the user is not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1978, titled *IEEE Standard Digital Interface for Programmable Instrumentation.*

PIN	LINE	
1	DIO1	
2	DIO2	
3	DIO3	
4	DIO4	
13	DIO5	
14	DIO6	
15	DIO7	
16	DIO8	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD-CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	



CAUTION

The 5006A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10833A, B, C, D HP-IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follows.



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Programming and Output Data Format

Refer to Section III, Operation

Mating Connector

HP 1251-0293; Amphenol 57-30240

Mating Cables Available

HP 10833A, 1 metre (3.3 ft.), HP 10833B, 2 metres (6.6 ft.), HP 10833C, 4 metres (13.2 ft.), HP 10833D, 1/2 metre (1.6 ft.)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).
3. The maximum number of instruments in one system is fifteen.

Figure 2-3. Hewlett-Packard Interface Bus Connections

HP-IL

2-22. HP-IL INTERCONNECTIONS (Option 030)

2-23. The 5006A with Option 030 is compatible with the Hewlett-Packard Interface Loop. The interface connection is made by a pair of two-wire balanced line cables. The cable is limited to 10 metres (32.8 feet) for unshielded cables (from one device to the next) and to 100 metres (328 feet) for shielded cables. A typical interface connection is shown in *Figure 2-4.*

HP-IL

The above symbol when located in the upper corner of a page indicates HP-IL information is contained on that page. This information may be operation, performance, adjustment, or service related.

2-24. HP-IL Description

2-25. An introductory description of HP-IL is provided in Section III of this manual. As HP-IL is a relatively new concept, it is recommended that users unfamiliar with the Interface Loop concept review this material prior to operating the instrument remotely. Additional information is available in *An Introductory Guide to the Hewlett-Packard Interface Loop,* published by McGraw Hill.

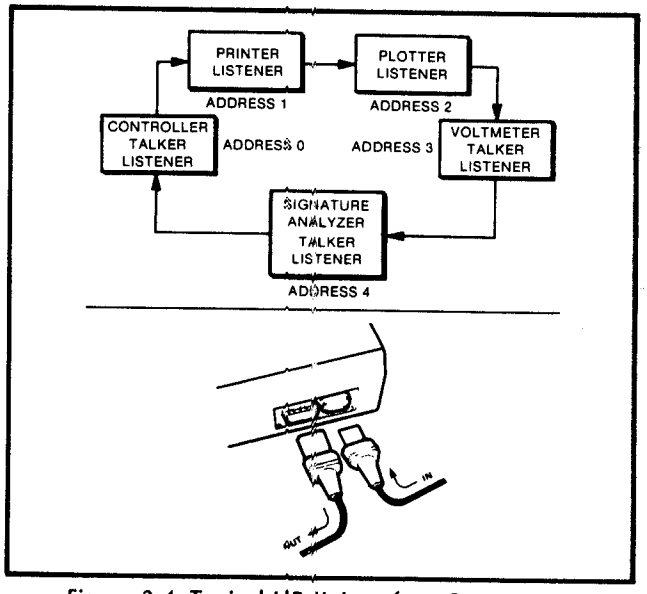


Figure 2-4. Typical HP-IL Interface Connection

2-26. OPERATING ENVIRONMENT

2-27. TEMPERATURE. The 5006A may be operated in temperatures from 0°C to +55°C.

2-28. HUMIDITY. The 5006A may typically be operated in environments with humidity up to 95% at 40°C. However, it should be protected from extreme temperatures which cause condensation in the instrument.

2-29. ALTITUDE. The 5006A may be typically operated at altitudes up to 4,600 metres (15,000 feet).

2-30. STORAGE AND SHIPMENT

2-31. Environment

2-32. The instrument may be stored or shipped in environments within the following limits:

TEMPERATURE: −40°C to +75°C
HUMIDITY: Up to 95% noncondensing
ALTITUDE: 15,240 metres (50,000 feet)

2-33. The instrument should also be protected from temperature and humidity extremes which cause condensation within the instrument.

2-34. PACKAGING

2-35. ORIGINAL PACKAGING. Containers and materials identical to those used in the factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-36. OTHER PACKAGING. The following general instructions should be used for repacking with commercially available materials.

a. Wrap instrument in heavy paper or plastic. If shipping to Hewlett-Packard office or service center, attach tag indicating type of service required, return address, model number, and full serial number.

b. Use strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container. Protect control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

f. In any correspondence, refer to instrument by model number and full serial number.

SECTION III
OPERATION AND PROGRAMMING

3-1. INTRODUCTION

3-2. This section gives complete operating and programming information for the 5006A Signature Analyzer. Descriptions of all front panel controls, connectors, and indicators, as well as an operator's check, operating instructions, and operator's maintenance, are provided.

3-3. OPERATING CHARACTERISTICS

3-4. The 5006A Signature Analyzer is a test instrument capable of both normal and qualified (QUAL) signature measurements. The 5006A has a maximum clock frequency of 25 MHz. Polarities for the Timing Pod Clock, Start, Stop and Qual inputs are selectable. Input trigger thresholds are preset to standard TTL logic levels (0.8 volts low, 2.0 volts high for Data Probe, and 1.4 volts for the Timing Pod inputs). The thresholds may be modified to CMOS logic levels via a CMOS sense input located on the front panel. In addition to the standard Signature Analysis capabilities, the 5006A features the following unique enhancements to signature measurements.

3-5. Automatic generation of a unique "composite" signature, representative of the set of all signatures intentionally probed since CLEAR or Power-up. This provides a method of verifying the proper operation of an entire IC, bus, or circuit, through a single signature.

3-6. An on-board memory stack which stores up to thirty-two sequential signatures. The signatures in memory can be reviewed, edited, or added-to.

3-7. A selectable Signature Latch function for the display. If enabled, the displayed signature will be held or "latched" in the display until replaced by another triggered measurement or cleared. A selectable Unstable Signature Latch function for the UNSTABLE LED. If enabled, a momentary unstable signature will cause the UNSTABLE LED to light and remain lighted until cleared or the function is disabled.

3-8. Input connectors on the front panel to configure the 5006A for a complete operation verification.

3-9. The 5006A is fully programmable, through either the HP-IB or HP-IL optional interfaces. Interface access is provided not only to the current signature, but also the keyboard, the signature memory, and the logic probe light. For example, the user can even use the 5006A as an interfaceable logic probe.

3-10. OPERATING INSTRUCTIONS

3-11. Information and instructions for operating the 5006A in both the local and remote modes are provided in this section. The following paragraphs summarize the organization and content of the operating information.

3-12. LOCAL OPERATION. The operating information for local (or manual) operation of the 5006A consists of the following topics:

General Operation Information. Begins with paragraph 3-39, and describes the basic operation of the instrument LEDs, Data Probe switch, Signature Memory, Composite Signature, and selectable functions and polarities.

Front and Rear Panel Features. Consists of Figures 3-9 through 3-12, which locate and describe all of the front and rear panel operator controls and indicators.

Making Signature Analysis Measurements. Begins with paragraph 3-85, and provides a description of the modes of Signature Analysis available, illustrates the timing relationships of the inputs, and lists the recommended procedure for making a measurement.

3-13. REMOTE OPERATION. The remote programming operating instructions begin with paragraph 3-96. A good working knowledge of the local operation of the 5006A is essential for remote programming, as most of the data messages perform the same keystroke-like sequences. Where applicable, program examples are provided. The Remote Operation/Programming instructions describe the following:

Interface Description
Interface Functional Overview
Interface System Terms
Address Selection
Front Panel Interface Status LEDs
Interface Function
Interface Messages
Input Format
Output Format
Measurement Triggering in Remote
SRQ, SRQ Mask, and Status Byte
Device Dependent Commands
Programming Examples

3-14. SIGNATURE ANALYSIS

3-15. Signature Analysis (SA) is a technique for component-level troubleshooting. A Signature Analyzer detects and displays the unique digital signatures associated with the data at nodes in a circuit under test. By comparing these actual signatures to known correct ones, a troubleshooter can quickly backtrace to a faulty node.

3-16. The 5006A Signature Analyzer displays a compressed, four digit "fingerprint" or signature of the digital data stream at a logic node. The special characters presented on the display represent the residue in a CRC (Cyclical Redundancy Code) shift register in the 5006A, after START and STOP signals have been received. The number of data bits between the START and STOP signal can be 1 to ∞ (infinity).

3-17. The four character front panel Signature Analysis display presents numbers in a special set of hexadecimal symbols. The 16 special hexadecimal characters used for signature displays are:

3-18. Notice that the final six symbols are not the common hexadecimal symbols "ABCDEF". The seven-segment LED displays used in the 5006A cannot show a "B" or "D" that would appear different from an "8" or "0", respectively. Also, several other symbols could be misinterpreted as another character when viewed upside-down (e.g. E → 3).

Note

No signature appearing on the 5006A display has any particular significance beyond being a correct (expected) signature or an incorrect signature. The number is, however, a residue in the 5006A converted to and displayed in special hexadecimal form.

3-19. SIGNATURE ANALYSIS LITERATURE

3-20. Further Signature Analysis information literature is listed in Application Note 222-0, *An Index to Signature Analysis Publications.* This maintained document lists the description and part number of the available literature concerning Signature Analysis, which can be ordered through the nearest Hewlett-Packard Sales and Service Office.

3-21. DATA PROBE AND TIMING POD HOLDER

3-22. The 5006A provides as an accessory a metal bracket designed as a convenient holder to store the Data Probe and Timing Pod. The holder may be used during either bench or rack mounted operation. For bench operation, the holder may be installed on the left front side of the instrument. For rack mounting, install the holder on the rack flange. Installation of the holder is optional.

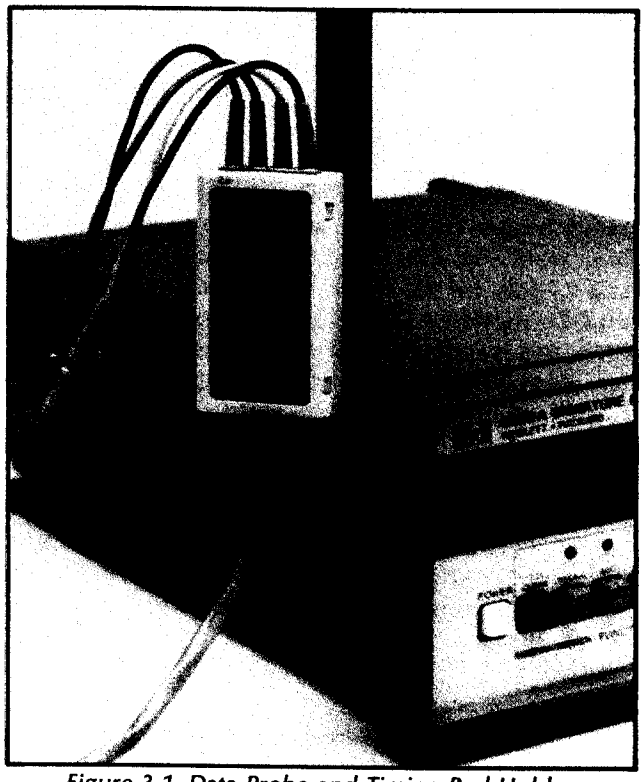


Figure 3-1. Data Probe and Timing Pod Holder

3-23. TEST TERMINAL GRABBER CONNECTIONS

3-24. Five test-terminal grabber connectors are supplied with the 5006A. A grabber can be used on the end of the Timing Pod leads to make reliable electrical connections from the 5006A to the instrument being tested. To connect a grabber to a test lead of the Pod, simply press the grabber on to the lead as shown in *Figure 3-2.* To place a grabber on an IC pin, grasp the grabber and compress the thumbhold. This allows the metal hook to open and be placed on the desired IC pin. To remove the grabber, compress the thumbhold and remove the grabber from the IC pin. A grabber is also provided for the removable ground (⊥) test lead for the Data Probe.

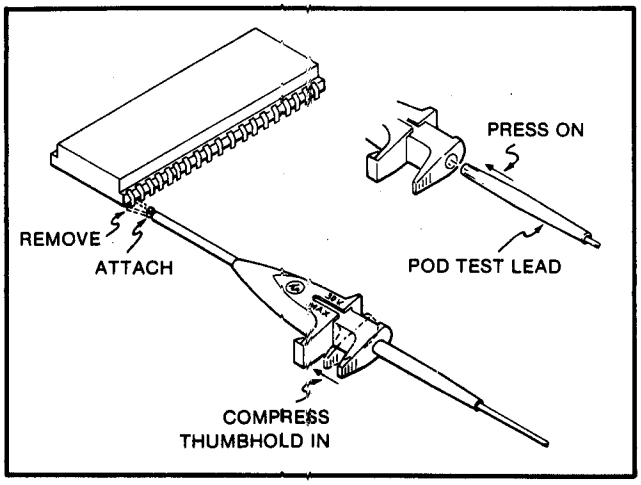


Figure 3-2. Test Terminal Grabber Connections

3-25. TYPICAL CONNECTIONS OF 5006A TO DEVICE UNDER TEST

3-26. *Figure 3-3* shows the 5006A Signature Analyzer connected to another device, taking signatures.

3-27. PANEL FEATURES

3-28. The front and rear panel connectors, indicator, and controls of the 5006A are described in *Figures 3-9, 3-10, 3-11,* and *3-12.* These figures locate and describe all operator accessible front and rear panel features.

3-29. OPERATOR'S MAINTENANCE

3-30. The only maintenance the operator should normally perform is the replacement of the line fuse. This fuse is located on the rear panel. Refer to Section II, Line Voltage Selection, for instructions on changing the fuse.

CAUTION

Make sure that only fuses with the required rated current and voltage, and of the slow-blow type are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

3-31. POWER-UP SELF-CHECK

3-32. When the 5006A is turned-on, a power-up self-check cycle is automatically started. With no inputs applied to the Data Probe or Timing Pod, the sequence is as follows:

1. After pressing the POWER switch in to switch the instrument from off to on, all the display segments and LED indicators on the front panel and display, except for the GATE LED, should light momentarily.

2. After approximately two seconds, the interface address (if installed) will be displayed momentarily, formatted as follows: "Ad.10" for interface address ten.

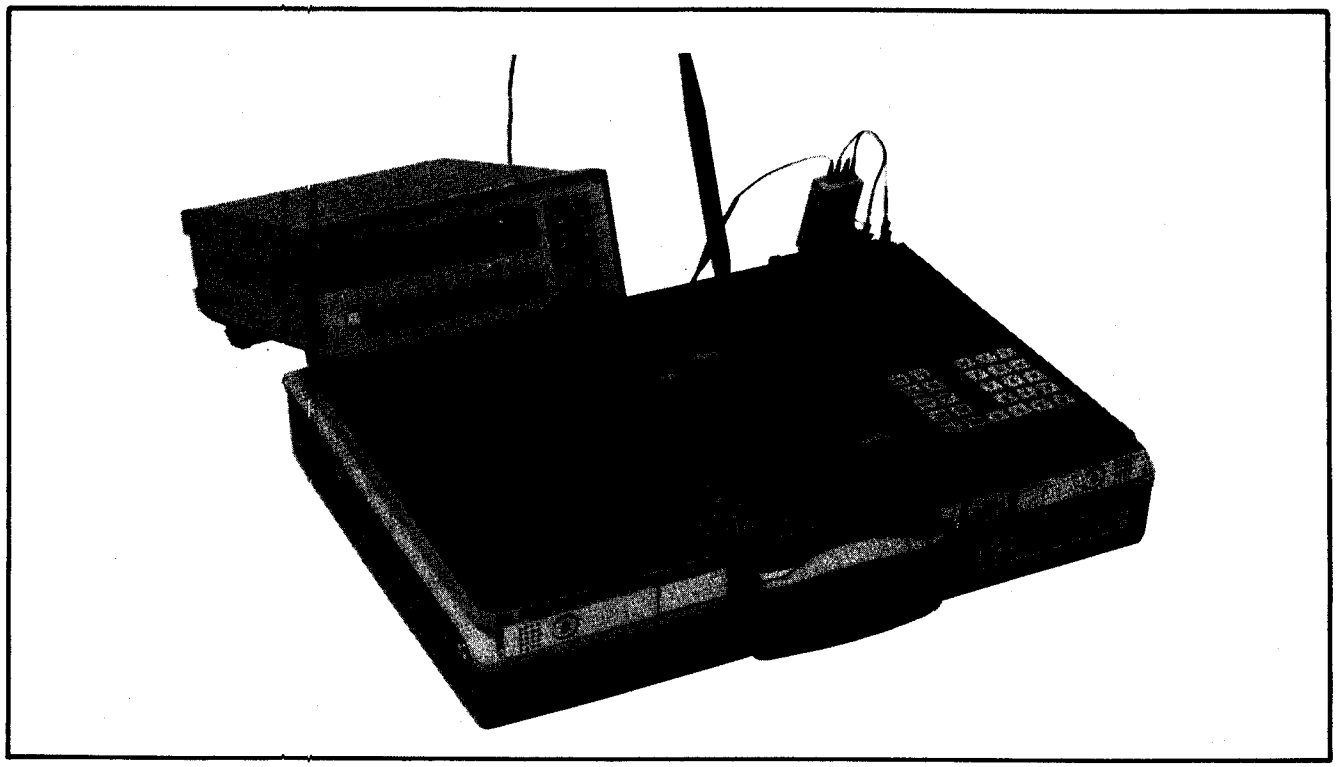


Figure 3-3. Typical Connections of 5006A to Device Under Test

3. Successful completion of the power-up self-check is indicated when the front panel assumes its power-up default state; all FUNCTIONs off, the CLOCK, START, and STOP POLARITIES to "rising edge" (indicated by the lighted LEDs above the keys), QUAL polarity to off, and the four dashes (center segments) of the display are lighted. All other front panel LEDs are off.

3-33. During this cycle, the microprocessor performs a checksum of the internal program in ROM, and a bit pattern is written into and read from RAM. Problems during the power-up self-check will usually result in a visibly improper state of the front panel display and indicators or the display of a numbered error or failure message. Error messages, which are preceded by "Er", can be cleared by pressing the CLEAR key, and the operation reattempted. Failure messages, which are preceded by "F-" or an improper power-up display state may also be cleared by pressing the CLEAR key, but typically indicate service is required.

3-34. ERROR AND FAILURE MESSAGES

3-35. Problems during the power-up self-check, the Operation Verification, or during local or remote operation typically result in an error or failure condition, detected by the 5006A and identified by a specific numbered message. The 5006A separates problems into two classes; Errors and Failures.

3-36. Errors are defined as problems which occur because of the manner in which the instrument is operated, but where no hardware failure is present. These conditions usually indicate an attempted incorrect operation such as an illegal numeric parameter, or an incorrect key operation. Error messages can be "cleared", allowing correction of the problem and the operation to be repeated. Error messages are assigned numbers 01, 02, 50's, and 70's, and are preceded by the letters "Er" in the display. The 5006A Error messages are shown in *Table 3-1.*

3-37. Failures indicate a hardware type problem, and generally require the instrument to be serviced. Failure messages are categorized by area of failure. Failure messages are assigned numbers ranges 10's, 20's, 30's, 40's and 60's, and are preceded by "F-" in the display. The 5006A Failure messages are shown in *Table 3-1.*

3-38. When a problem is detected in either the motherboard or in the interface, the information is transmitted from the one to the other. When the motherboard either finds a problem or receives the code for one from the interface, it stops the operation of the instrument and displays the appropriate code. When the interface detects or receives a problem it stores this information and sets the error bit in the serial poll status byte. The CLEAR key on the front panel must be pressed or a device clear received from the interface to clear the error and resume operation. All other keys and commands will be ignored.

Table 3-1. Error and Failure Messages

Operator EDIT Errors	
Er01	Attempted EDIT with no signatures in memory
Er02	Attempted EDIT of COMPOSITE SIGNATURE
Interface Command/Protocol Errors	
Er50	Unrecognized command
Er51	Illegal numeric parameter
Er52	Illegal character in command
Er55	HP-IL loop protocol error
External Interface Connection Errors	
Er70	Controller connected to talk-only instrument
Microprocessor Failures	
F-10	ROM failure
F-11	Working RAM failure
F-12	Signature memory RAM failure
F-13	Timer failure
Microprocessor to Motherboard Connection Failures	
F-20	Data bus latch failure
F-21	Data bus latch enable failure
F-22	Digit driver failure
F-23	Input port failure
F-24	Nonexistent key failure
Motherboard Failures	
F-30	Data probe does not recognize lows
F-31	Data probe does not recognize highs
F-32	Measurement gate failure, closed when should be open
F-33	Measurement gate failure, open when should be closed
F-34	Incorrect signature
Motherboard to Interface Card Connection Failures	
F-40	Interface power-up failure
F-41	Interface timeout on input
F-42	Interface timeout on output
Interface Card Microprocessor Failures	
F-60	ROM failure
F-61	RAM failure

3-39. GENERAL OPERATION INFORMATION

3-40. Introduction

3-41. The following paragraphs describe general operating features of the 5006A Signature Analyzer.

3-42. Power-Up Default States

3-43. When power is initially applied to the 5006A, the instrument automatically assumes the power-up default states listed in *Table 3-2.*

Table 3-2. Power-Up Default States

FUNCTION	RECALL	OFF
	EDIT	OFF
	SIG LATCH	OFF
	UNSTABLE LATCH	OFF
	QUAL	OFF
POLARITY	CLOCK	RISING
	START	RISING
	STOP	RISING
	QUAL	Inactive

3-44. To change from the power-up state to any other function or polarity, refer to paragraphs 3-68 or 3-77 respectively. The input triggering thresholds for the Data Probe and Timing Pod are preset to TTL levels. To change from TTL trigger thresholds to CMOS levels, refer to paragraph 3-83.

3-45. Operation of the GATE LED

3-46. The flashing front panel GATE LED indicates that the instrument is being clocked and is actively gating. The GATE LED is a hardware driven LED which flashes at either a 5 Hz rate, or the actual gate rate (whichever is slower). It is important to realize that the GATE LED is only an indicator of clock and gate activity. It does not necessarily reflect the actual gate rate or duration.

3-47. Operation of the COMPOSITE SIGNATURE LED

3-48. The front panel COMPOSITE SIGNATURE LED indicates that the current displayed signature is the Composite Signature. The instrument must be in the RECALL function to access and display the Composite Signature. The Composite Signature is also identified by four lighted decimal segments in the display.

3-49. Operation of the UNSTABLE LED

3-50. The front panel UNSTABLE LED indicates an unstable signature condition. A signature must measure identically for two consecutive gate cycles to be considered stable. The UNSTABLE LED will light whenever a signature is found that is not identical to the previous signature. The UNSTABLE LED will turn off when two identical signatures in a row are found, or after 100ms (whichever is longer). If the UNSTABLE LATCH function is active, the UNSTABLE LED will light and remain lighted until the CLEAR function is performed.

3-51. Operation of the Data Probe Tip LED

3-52. The Data Probe tip LED normally operates as a logic indicator, reflecting the electrical activity at the probe tip. The logic state at the tip is sampled over ≈100ms intervals. If neither a high nor a low is seen during the interval, the probe LED will be set to DIM (indicating high-impedance). If both a high and a low are seen, the LED will blink on and off to indicate activity. A steady high will cause the LED to turn on BRIGHT, a steady low will cause the LED to turn OFF.

3-53. The only time (other than Self-Test) that the probe LED does not operate as a logic indicator is during a triggered signature measurement. After a trigger (probe switch press) is received, the probe LED will turn on BRIGHT (during the measurement). When the measurement is complete, the probe LED will turn off, then resume normal logic activity.

3-54. Operation of the Data Probe Switch

3-55. The Data Probe switch (pushbutton) acts as a trigger signal to the instrument. The Data Probe switch is the only instrument key which cannot be locked out by the interface, and is one of only two keys (along with LOCAL) still active while in REMOTE. The Data Probe Switch, as shown in *Table 3-3,* is utilized for several functions, depending on the instrument mode of operation.

Table 3-3. Probe Switch Functions

Mode	Data Probe Switch Function
NORMAL	Initiates a "Triggered" signature measurement which is stored in memory and represented in the Composite Signature.
SIG LATCH	Initiates a "Triggered" signature measurement which updates the display. The signature is stored in memory and represented in the Composite Signature.
RECALL	Increments or "rolls" the memory stack through the display. Each keypress decrements the memory one measurement.
EDIT	Initiates a "Triggered" signature measurement which replaces the last signature stored in memory and recalculates the Composite Signature accordingly. When used with RECALL, initiates a "Triggered" signature measurement which replaces the currently displayed signature in memory and recalculates the Composite Signature accordingly.
SELF-TEST	Shifts the Self-Test Operation Verification sequence from the general PASS/FAIL test to a single segment display verification routine. Each LED and display segment on the front panel is lighted momentarily. When finished, returns to the standard Self-Test routine.
REMOTE	Performs all functions as in local, plus the following additional uses unique to remote operation; initiates a "Triggered" signature measurement which is then available to the interface, initiates a "Triggered" signature measurement and then automatically outputs the Logic Status of the probe to the interface, can be specified in the Service Request Mask to generate an SRQ condition when pressed.

3-56. The Data Probe switch is used to select the signatures to be entered into the memory. When the Data Probe switch is pressed during normal operation, the next single measurement to start is known as a "triggered" signature measurement. Triggered signatures are (always) stored into the signature memory, and are the only signatures stored there. Triggered signatures are the only signatures represented in the Composite Signature.

3-57. With the SIG LATCH function enabled, the Data Probe switch must be pressed to initiate a "triggered" signature measurement (as described in Para. 3-56) in order to update or change the displayed signature. Only triggered signatures will be displayed with the SIG LATCH function. The Data Probe switch allows the user to make measurements in a "sample and hold" fashion.

3-58. While in the RECALL function, the Data Probe switch is used to increment or roll the memory stack through the display. While in the EDIT function, the Data Probe switch is used to trigger a new signature to replace the signature displayed. The new signature acquired after pressing the Data Probe switch assumes the position and reference number of the previously "recalled" signature.

3-59. During the Self-Test Operation Verification, the Data Probe switch is used to shift the test sequence to a single segment display verification routine. The Data Probe switch can also be utilized interactively during remote operation.

3-60. The 5006A Signature Memory

3-61. The 5006A contains a dedicated memory, to accumulate up to thirty-two triggered signatures. In operation, the signature memory acts as a push-down stack. That is, entries are pushed onto the top of the stack. After the stack is full, signatures are lost off the bottom.

3-62. The 5006A automatically assigns each stored signature a reference number. This number is used to locate the signature during the RECALL or EDIT functions. The signatures are numbered in the order in which they are entered. The first signature is "1", the second is "2", and so on. Numbering continues incrementally even after the memory is full. For example, if thirty-four signatures were entered into the memory (refer to *Figure 3-4),* the most recent entry would be number "34" and the oldest retrievable entry would be "3" (1 and 2 would be lost). Numbering continues until either the memory is CLEARED or the instrument is turned off then on. Only two digits are used for numbering. When the number of stored signatures exceeds 99, only the last two significant digits are displayed on recall.

3-63. THE 5006A COMPOSITE SIGNATURE

3-64. The 5006A automatically generates a unique "Composite Signature" after each triggered signature measurement. The Composite Signature is a computed signature, representative of the binary sum of all the triggered signatures accumulated since the last CLEAR or power-up. Only triggered signatures (those preceded by pressing the Data Probe Switch) can affect the Composite Signature. In operation, the Composite Signature is automatically recalculated and updated with each new measurement, based on two factors; the previous Composite Signature and the new triggered signature. In this manner, the Composite Signature remains representative of all signatures taken, even after signatures have dropped off the bottom of the memory stack.

3-65. The Composite Signature can be reviewed at any time by pressing the front panel RECALL key. In the RECALL function, the Composite Signature is identified in two ways; the front panel COMPOSITE SIGNATURE LED annunciator lights and all four decimal points in the display light. See *Figure 3-5.* To return to normal operation press RECALL a second time to turn the function off.

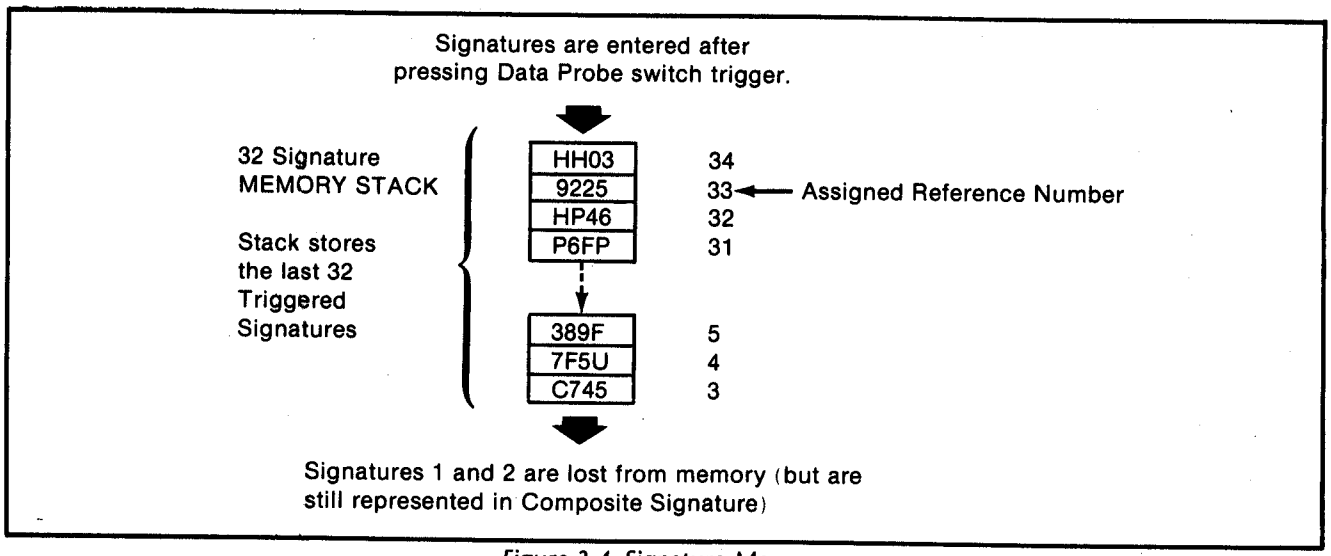


Figure 3-4. Signature Memory

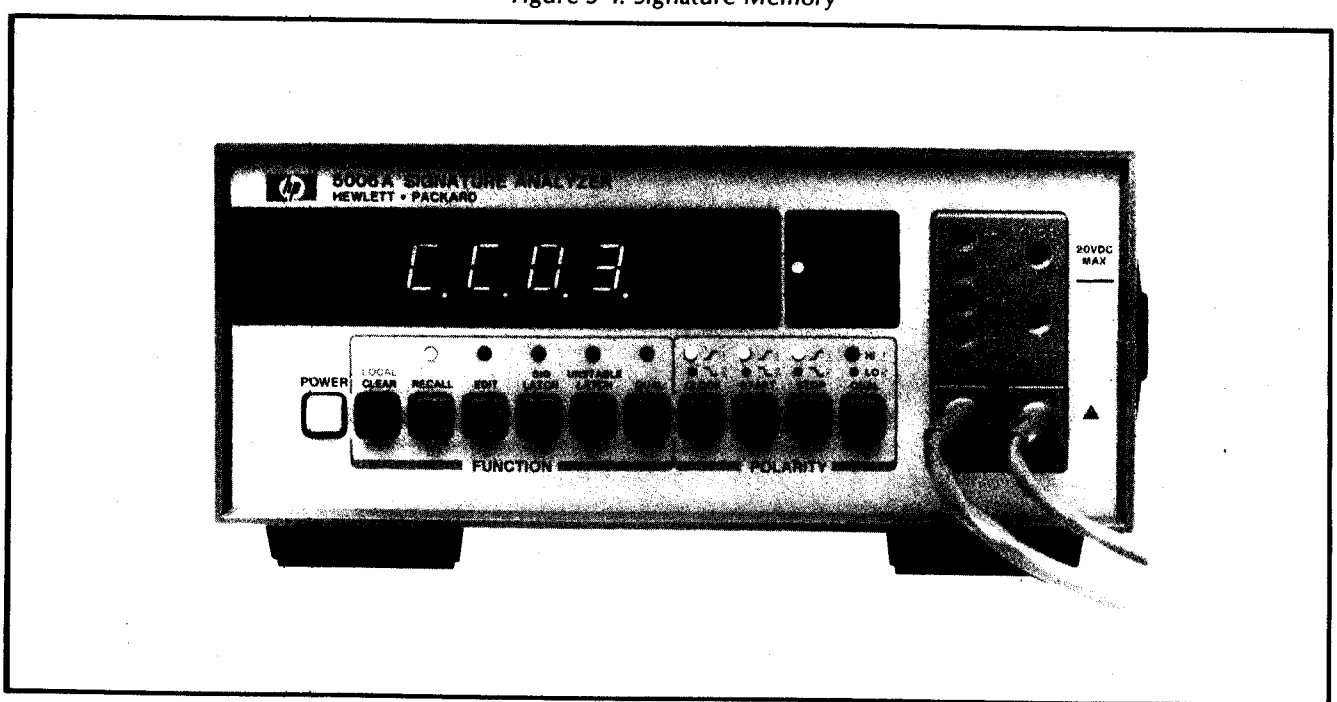


Figure 3-5. Composite Signature Display

3-66. The Composite Signature is very useful for identifying an area of circuitry or a number of nodes by one verified signature. For example, the Composite Signature for all pins of a forty-pin IC may be documented. To verify the proper operation of the IC, probe each pin of the device, entering the signature by pressing the Data Probe switch. The measurements do not have to be entered in any specific order, although entering them in order will keep the pin and reference numbers consistent. When you have finished probing all the pins, press the RECALL key to display the Composite Signture. If the displayed Composite Signature matches the documented signature, all forty signatures are correct.

3-67. A Composite Signature can be used to represent as many signatures as you like, from a single pin to an entire circuit board. You should be aware that the larger the number of pins involved, the greater the chance of a duplication or misprobe. Approximately twenty-four measurements per composite signature is generally a safe and convenient amount.

3-68. Selecting FUNCTIONS

3-69. The 5006A provides six measurement functions selectable through front panel keys. The functions are: LOCAL/CLEAR, RECALL, EDIT, SIG LATCH, UNSTABLE LATCH, and QUAL.

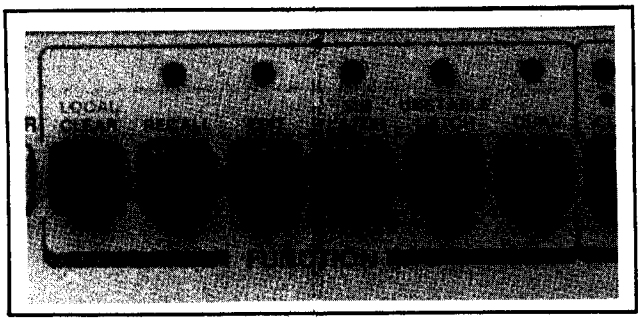


Figure 3-6. Front Panel FUNCTION Keys

3-70. LOCAL/CLEAR. For both local and remote operation, the LOCAL/CLEAR function clears the 5006A display, composite signature, signature memory, and UNSTABLE LED, and resets the gate state machine. It also aborts any measurements in progress and clears any pending "Send Data" commands. If in remote, this function also returns the instrument to local. The CLEAR function may also be used to clear an instrument Error or Fail state. If an Error or Fail message is displayed, the first press of the CLEAR key clears the message from the display allowing the instrument to continue operation (if possible). A second press of the CLEAR key clears the display and memories as described above.

3-71. RECALL. The RECALL function accesses the Composite Signature and signature memory. Pressing the RECALL key selects the function and turns on the LED above the key. If EDIT is disabled (off) and RECALL is enabled (on) the 5006A enters its only non-measuring mode. In this mode, none of the front panel keys other than CLEAR, RECALL, and EDIT can affect operation. The UNSTABLE LED will be off, although the Data Probe LED and GATE LED will retain their normal functions.

3-72. The initial display in RECALL will be the Composite Signature, indicated by the lighting of the front panel COMPOSITE SIGNATURE LED and all four decimal points in the display. The Composite Signature and the most recent triggered signatures (up to 32) can be reviewed by pressing the Data Probe switch. With each press of the Data Probe switch, a two-digit reference number is displayed followed by the corresponding signature. The signatures in memory are accessed in reverse order, beginning with the most recent entries (the highest reference numbers). No more than 32 signatures can be stored at one time. Signatures are reviewed in a scrolling fashion, eventually returning to the Composite Signature, then beginning again.

3-73. EDIT. The EDIT function allows signatures stored in memory to be replaced with new measurements. The EDIT function, by itself, allows the replacement of the last triggered signature placed into memory. EDIT, in conjunction with the RECALL function, allows replacement of any of the (up to 32) signatures in memory. To replace the "last" signature stored, press EDIT (the EDIT LED will light), place the Data Probe tip on the desired node for the replacement measurement and press the Data Probe switch. The last triggered signature stored will be replaced with the measurement just taken. No visual indication of the replacement is returned; however, you may verify the edit through the RECALL function. To edit a signature other than the last entry, select RECALL, then use the Data Probe switch to scroll through the memory until you find the signature you want to edit. The initial display in RECALL will be the Composite Signature, which cannot be edited. Each press of the Data Probe switch will increment the signature memory, displaying first the reference number, then the corresponding signature. The signature which appears in the display is the signature that will be edited. Once the desired signature is displayed, press EDIT. The signature can be replaced by inputting the new signature . The new signature is input by placing the Data Probe tip on the desired node and pressing the data probe switch. Whenever a signature in memory

is edited (replaced), the Composite Signature is automatically recomputed, to reflect the change. Signatures placed in the memory cannot be purged, only replaced through EDIT. You may edit signatures in memory as often and as many times as you wish.

3-74. SIG LATCH. The Signature Latch function selects only triggered signatures to be displayed or made available to the interface. The display will only update when a triggered signature is received. A triggered signature is a signature preceded by a press of the Data Probe switch or the remote GET command. Note that the operation of the UNSTABLE LED is independent of this function. If the probe is placed on an unstable node, the UNSTABLE LED will light even if the probe switch is not pressed. This allows the user to place the probe on a node and determine that the node is stable before enabling the trigger. If an unstable signature is entered, the UNSTABLE LED will not remain latched on unless the UNSTABLE LATCH function is on also. The LED above the SIG LATCH FUNCTION key will be lighted whenever the function is enabled.

3-75. UNSTABLE LATCH. The Unstable Latch function sets the unstable signature circuits to an armed/latch configuration. When the Unstable Latch function is selected, any unstable signature through the probe will cause the UNSTABLE LED to light. Note that this function does not require triggered signatures, and monitors all signatures input through the probe. The UNSTABLE LED will remain lighted until either the CLEAR key is pressed or the UNSTABLE LATCH function is turned off. This mode allows a user to connect the instrument to a system under test, leave it unattended, then return later and determine if the signature had remained stable. The LED above the UNSTABLE LATCH FUNCTION key will be lighted whenever the function is enabled.

3-76. QUAL. The Qual function adds a qualifier to the timing inputs. If QUAL is selected, clock edges will be accepted only when the logic level on the STOP/QUAL input is at the level set by the QUAL POLARITY key. The LED above the QUAL FUNCTION key will be lighted whenever the function is enabled.

3-77. 5006A POLARITY Selections

3-78. The 5006A interprets the Timing Pod input signal levels according to the settings of the POLARITY keys. That is, the active trigger edge (or state) for each of the Timing Pod inputs is selectable with the front panel POLARITY keys. The power-up state for the POLARITY keys is "rising edge" for CLOCK, START, and STOP, with QUAL set to off.

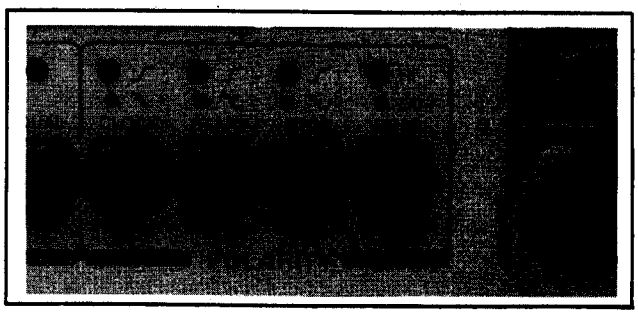


Figure 3-7. Front Panel POLARITY Keys

3-79. All four POLARITY keys, CLOCK, START, STOP, and QUAL, operate in a simple toggle fashion. Each keypress toggles the polarity to the complementary state. To change the POLARITY edges for the CLOCK, START, STOP, or QUAL (if the QUAL function is enabled) Timing Pod inputs, press the corresponding labeled key.

3-80. For any selected POLARITY key, LED indicators above the key identify the active logic edge or level as follows. For CLOCK, START, and STOP inputs, a lighted LED indicates the "rising edge" is selected, an unlighted LED indicates the "falling edge" is selected. For the QUAL input, a lighted LED indicates that a "HI" level is required to enable the measurement, an unlighted LED indicates that a "LO" level is required to enable the measurement. The QUAL Function must be activated before a QUAL Polarity can be selected.

3-81. Trigger Thresholds

3-82. The 5006A is pre-programmed to trigger on the standard logic thresholds for the TTL. The pre-programmed standard trigger threshold values for each input are given in *Table 3-4.* Notice that both a logic High and Low value are programmed for the DATA PROBE input, while only a logic family mean (midpoint) is required for the CLOCK, START, STOP, and QUAL inputs.

Table 3-4. Preset Trigger Thresholds

Data Probe	Clock	Start	Stop	Qual
2.00V High 0.80V Low	1.40V	1.40V	1.40V	1.40V

3-83. Selecting CMOS Input Logic Thresholds

3-84. The 5006A is pre-programmed to trigger on standard TTL logic levels. The actual trigger threshold values may be set to any level between +0.9 volts and +14.0 volts. To change the input trigger thresholds, connect the CMOS power supply (any level between +3.0 and 20.0 volts) to the 5006A front panel connector labeled "CMOS". The dc value will be sensed by the 5006A, and the trigger thresholds for the various inputs will be modifided as follows:

Data Probe Input	
Logic one	70% (nominal) of the reference value
Logic zero	30% (nominal) of the reference value
Timing Pod Inputs	
Logic mean	50% (nominal) of the reference value

3-85. MAKING SIGNATURE ANALYSIS MEASUREMENTS

3-86. Signature Analysis (SA) employs a unique data compression technique that reduces any long, complex data stream pattern on a logic node to a four-digit "signature". The operator supplies the Start and Stop signals to identify the data stream, and a Clock signal to control the sample rate of the probe input. An illustration of the timing involved in a Signature Analysis measurement window can be seen in *Figure 3-8.*

3-87. The following paragraphs describe the two signature analysis modes of operation for the 5006A.

3-88. Signature Analysis Measurements (Normal)

3-89. The 5006A makes Signature Analysis (SA) measurements on TTL and CMOS logic families. The trigger thresholds for the inputs are selectable from the standard preset values for TTL logic families, or determined from an external dc input for CMOS. The edge for the Clock, Start, and Stop inputs is selectable using the POLARITY keys. The Start signal is applied to the START/ST/SP (green) Timing Pod lead. The Stop signal is applied to the STOP/QUAL (red) Timing Pod lead. The Clock signal is applied to the CLOCK (yellow) Timing Pod lead, and the measurement is made through the Data Probe.

3-90. During SA measurements the front panel GATE LED indicator will flash if there are valid Start and Stop inputs and an active Clock input. The Data Probe tip LED acts as a logic state indicator, lighting "brightly" for a logic high state, "dimly" for a high-impedance state, and "off" for a logic low state. The Data Probe tip LED will "flash" to indicate activity at the node, however the flash duration is controlled by a pulse-stretching circuit and does not reflect the frequency of the input. The UNSTABLE LED will flash if there is a difference between two or more successive signatures.

3-91. Signature Analysis Measurements (Qualified)

3-92. The Qualified SA mode is selected by pressing the QUAL function key. The Qualified Signature Analysis mode is similar to the normal mode, but with the following enhancement. In this mode, the STOP/QUAL input on the Timing Pod is sensed as a "data qualifier". Conceptually, the qualifier can be thought of as "enable" signal. By controlling the logic state of this input, the operator can effectively window the signature measurement within a specific stream of data. Refer to *Figure 3-8.* The trigger thresholds for the inputs are selectable from the standard preset values for TTL, or determined from an external dc input for CMOS. The active edge or level for CLOCK, START, STOP and QUAL, is selectable using the POLARITY keys. When in the QUAL Signature mode, the red Timing Pod lead is the QUAL (qualifier) input, and the green Timing Pod lead is both the START and STOP input. The measurement is made through the Data Probe.

3-93. The operation of the GATE, UNSTABLE, and Data Probe tip LEDs during the SA QUAL mode is the same as in SA normal (see paragraph 3-88).

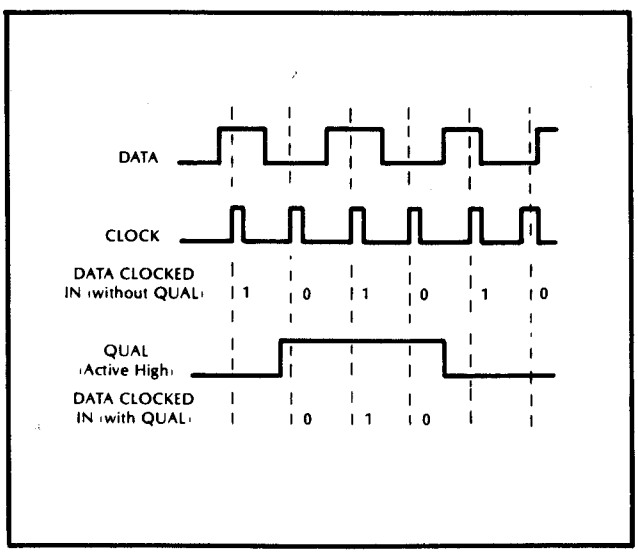


Figure 3-8. Signature Analysis Measurement Timing

3-94. Basic Measurement Procedure

3-95. The recommended sequence for setting-up and making a measurement with the 5006A is given below.

1. Set the 5006A POWER switch to ON. The 5006A should perform a power-up self-check, then preset to the power-up default settings described in paragraph 3-43.

2. Select the desired POLARITY edges for the CLOCK, START, and STOP Timing Pod inputs.

3. Activate the QUAL Timing Pod input, if desired, by pressing the QUAL FUNCTION key. Select the desired active enable level for the QUAL input with the QUAL POLARITY key; when the QUAL POLARITY LED is lighted, the active enable state is "HI", when the QUAL POLARITY LED is off, the active enable state is "LO".

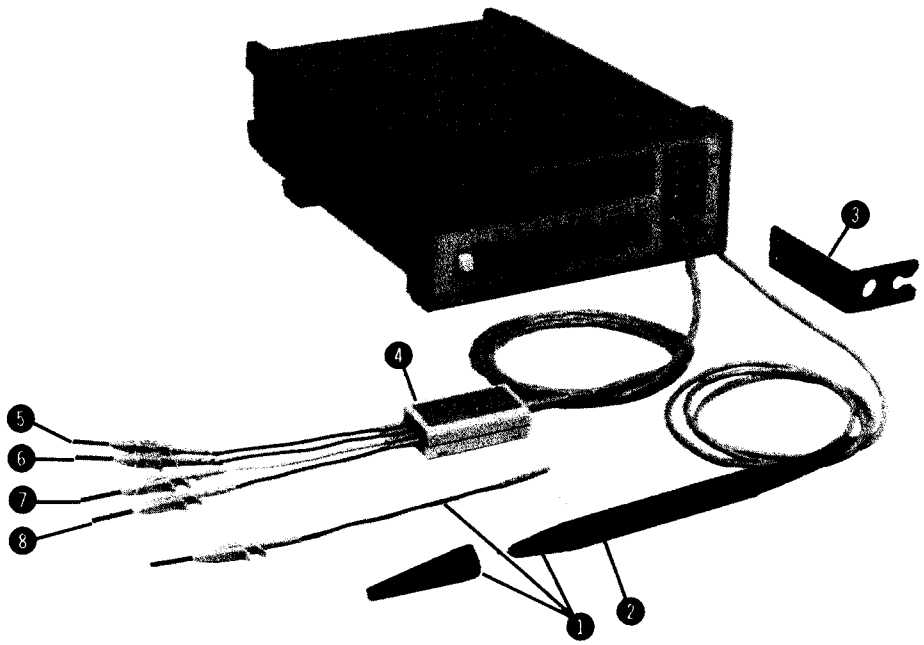
4. If the circuit logic under test is CMOS, input the CMOS power supply (+3V to +20V) into the front panel CMOS connector.

5. Select the SIG LATCH function, if desired, by pressing the labeled FUNCTION key. The SIG LATCH function displays only triggered signatures. The FUNCTION indicator LED above the key should light whenever the function is activated.

6. If desired, select the UNSTABLE LATCH function by pressing the labeled FUNCTION key. The UNSTABLE LATCH function monitors the Data Probe input for an unstable signature, latching the front panel UNSTABLE LED on if one is desired.

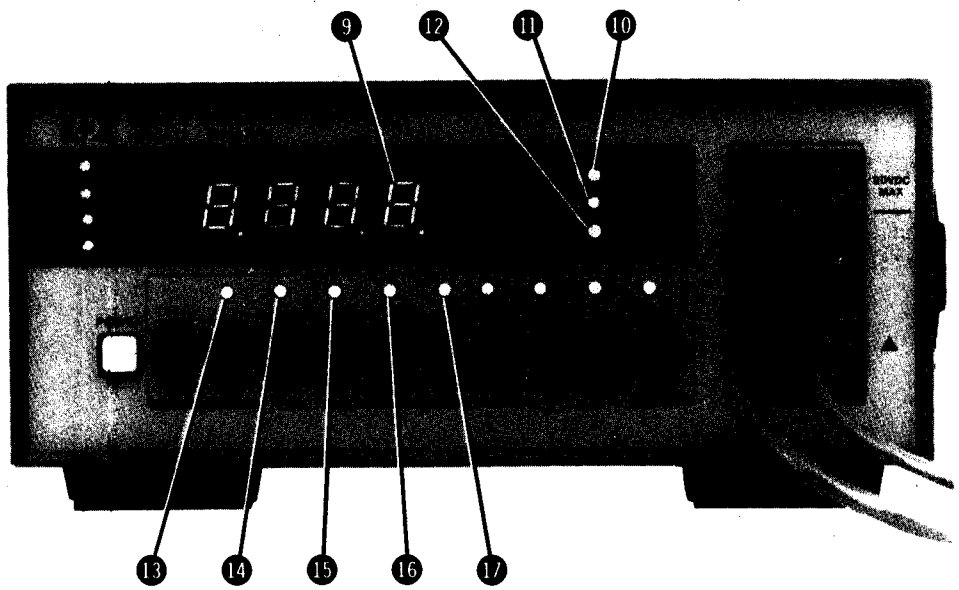
7. Connect the Timing Pod leads to the appropriate input signals. The GATE LED should be flashing.

8. Touch the Data Probe tip to the desired node. The node signature should be displayed, unless the Signature Latch function is on. To enter the displayed signature into the 5006A memory, press the Data Probe switch.



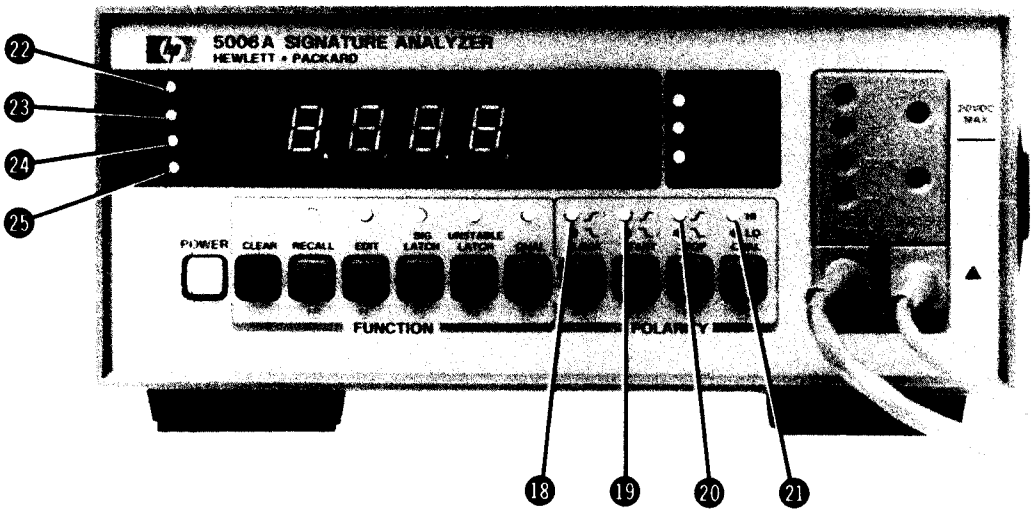
❶ **DATA PROBE, PROTECTIVE COVER, and GND LEAD**	Point of entry for data. The lamp within the probe tip indicates the logic state of the data: ON BRIGHT=High, ON DIM=High-impedance, OFF=Low, FLASHING=Activity. Note the removable ground connector wire (internally connected to earth ground) and protective cap cover for the Data Probe.
❷ **DATA PROBE SWITCH**	Used as an operator interactive prompt/response signal. Used to initiate a "triggered signature measurement" during SA functions, to scroll through the signature memory in RECALL, or to replace a signature in EDIT. The function of the Data Probe switch is identical for both local and remote operation.
❸ **DATA PROBE and TIMING POD HOLDER**	Accessory holder, used to store the Data Probe and Timing Pod when not in use. May be installed on either bench or rack mounted instruments.
❹ **TIMING POD**	Supplies the four timing inputs START/ST/SP, STOP/QUAL, CLOCK, and ⊥ (GND) from the unit under test to the 5006A Signature Analyzer.
❺ **START/ST/SP**	Point of entry for START signal in normal SA mode, and for both START and STOP signals in QUAL SA.
❻ **STOP/QUAL**	Point of entry for STOP signal in normal SA and for the QUAL signal in QUAL SA.
❼ **CLOCK**	Point of entry for CLOCK signal during normal and QUAL SA.
❽ **⊥ Ground**	Common ground lead between 5006A and device under test for all function modes. Note that this lead is internally connected to earth ground.

Figure 3-9. Signature Analyzer, Data Probe and Timing Pod Features



⑨ **DISPLAY**	Contains the four seven-segment LED displays.
⑩ **GATE LED**	Flashing of GATE LED indicates the 5006A is being gated. It does not indicate the frequency of the gate cycle.
⑪ **COMPOSITE SIGNATURE LED**	If lighted, indicates that the signature displayed is the computed Composite Signature derived from all the signatures taken since the last CLEAR or POWER-UP condition.
⑫ **UNSTABLE LED**	If lighted, indicates the current signature measurement is different from the previous signature measurement.
⑬ **RECALL LED**	If lighted, indicates the RECALL function is activated.
⑭ **EDIT LED**	If lighted, indicates the EDIT function is activated.
⑮ **SIG LATCH LED**	If lighted, indicates the SIGNATURE LATCH function is activated.
⑯ **UNSTABLE LATCH LED**	If lighted, indicates the UNSTABLE SIGNATURE LATCH function is activated.
⑰ **QUAL LED**	If lighted, indicates the QUAL function mode of SA is activated.

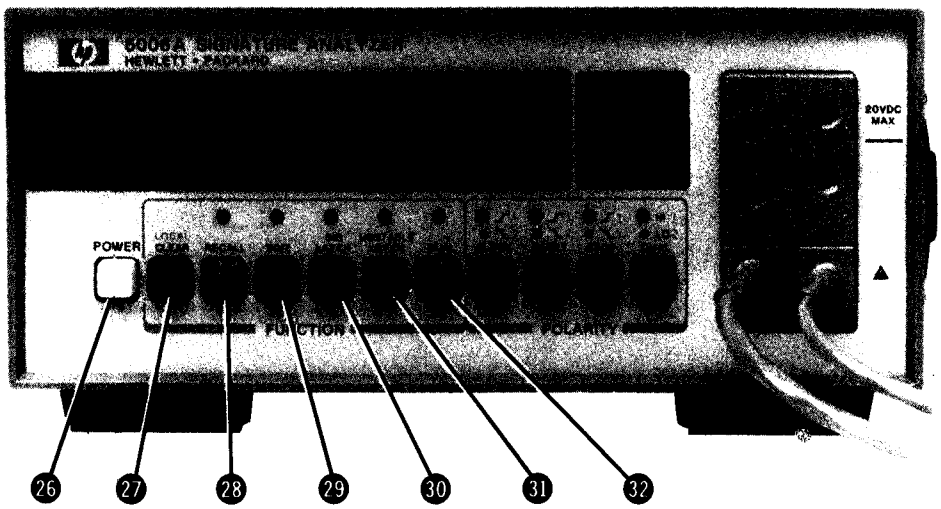
Figure 3-10. Front Panel Indicators



18	**CLOCK LED**	LED indicator for the status of the CLOCK Polarity.If lighted indicates rising edge selected, off indicates falling edge.
19	**START LED**	LED indicator for the status of the START Polarity.If lighted indicates rising edge selected, off indicates falling edge.
20	**STOP LED**	LED indicator for the status of the STOP Polarity. If lighted indicates rising edge selected, off indicates falling edge.
21	**QUAL LED**	LED indicator for the status of the QUAL Polarity. If lighted indicates HI level selected, off indicates LO level selected. The QUAL FUNCTION must be selected for QUAL POLARITY to be activated.
* 22	**REMOTE LED**	Interface status indicator. Lights when the 5006A is under remote control.
* 23	**TALK LED**	Interface status indicator. Lights when the 5006A is addressed to talk.
* 24	**LISTEN LED**	Interface status indicator. Lights when the 5006A is addressed to listen.
* 25	**SRQ LED**	Interface status indicator. Lights when the 5006A has requested service from the controller. SRQ may (or may not) generate an interrupt in the controller. The setting of the SRQ Mask determines whether or not an SRQ is issued.

**Provided only with Option 030 or Option 040.*

Figure 3-10. Front Panel Indicators (Continued)



26 POWER Key — Main power switch for the 5006A. Press and lock in to power the instrument. Press again, releasing the pushbutton, to remove power. When power is off, there are no components energized within the instrument, however, ac line voltage is present at the rear panel line connector and in the primary winding of the main power transformer.

27 CLEAR/LOCAL Key — With no Error or Failure displayed, this key will clear the memory of triggered signatures and the Unstable Signature LED. In remote operation, with no Error or Failure displayed, this key will return the instrument to "Local" operation and clear the memory of triggered signatures (unless the Local Lockout command has been issued). If an Error or Failure is displayed, this key will clear only the Error or Failure display. Pressing the key a second time will complete the CLEAR and LOCAL function.

28 RECALL Key — Selects the RECALL function. RECALL first displays the Composite Signature. Pressing the Data Probe switch accesses the triggered signatures stored in memory for review or edit, beginning with the most recent entry. Repeated presses of the Data Probe switch recall each of the stored signatures in reverse order.

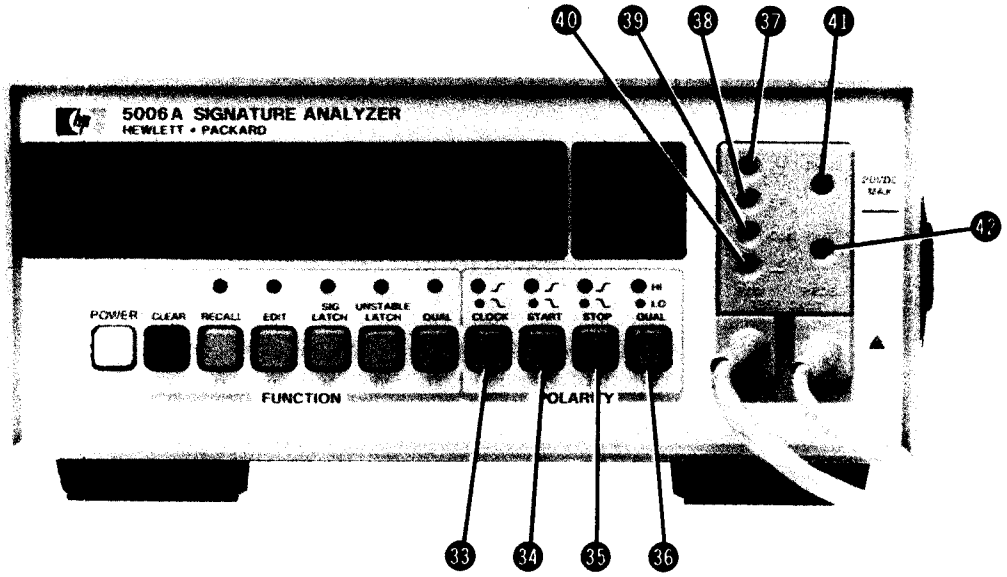
29 EDIT Key — Selects the EDIT function. EDIT allows replacement of the last triggered signature in memory, or in conjunction with RECALL allows replacement of any stored signature. Replacing a stored signature in memory causes the Composite Signature to change.

30 SIG LATCH Key — Selects the SIGNATURE LATCH function, which latches the last signature into the display. The Data Probe switch must be pressed to update the display.

31 UNSTABLE LATCH Key — Selects the UNSTABLE SIGNATURE LATCH function, which sets up the UNSTABLE LED to light and remain lighted whenever an unstable signature is detected.

32 QUAL Key — Selects the QUAL function mode of SA. In this mode, signature measurement is enabled by either the high (HI) or low (LO) level of the qualifying input signal.

Figure 3-11. Front Panel Controls



33 CLOCK Key — Selects the CLOCK Polarity. Pressing the CLOCK key toggles the current setting of the Clock polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.

34 START Key — Selects the START Polarity. Pressing the START key toggles the current setting of the Start polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.

35 STOP Key — Selects the STOP Polarity. Pressing the STOP key toggles the current setting of the Stop polarity, indicated by the LED above the key. A lighted LED indicates the rising edge, an unlighted LED indicates the falling edge.

36 QUAL Key — Selects the QUAL Polarity. Pressing the QUAL key toggles the current setting of the Qual polarity, indicated by the LED above the key. A lighted LED indicates a HI level selected, an unlighted LED indicates a LO level selected.

37 ST Connector — Test connector for START Timing Pod lead during Operation Verification test procedure.

38 SP Connector — Test connector for STOP Timing Pod lead during Operation Verification test procedure.

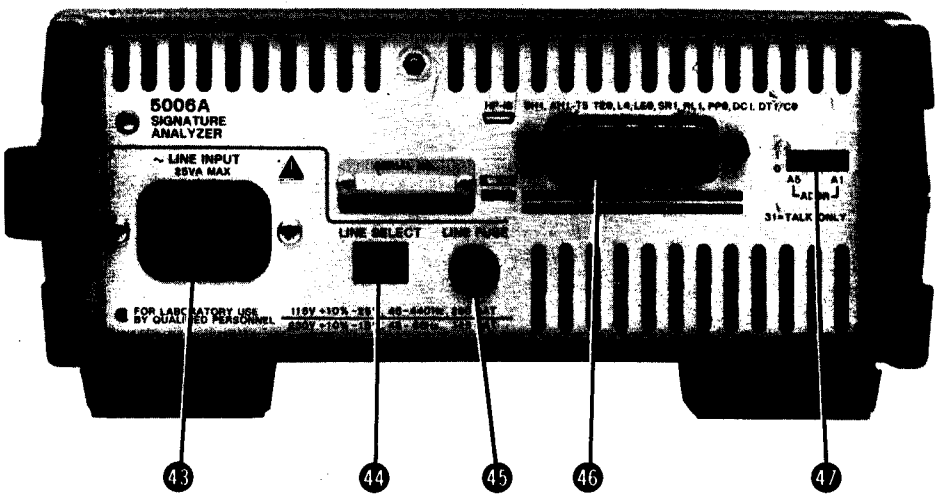
39 CLK Connector — Test connector for CLOCK Timing Pod lead during Operation Verification test procedure.

40 ⊥ Connector — Test connector for ⊥ (GND) Timing Pod lead during Operation Verification test procedure. **CAUTION: This connector is not connected to chassis ground (⊥) and is not at zero volts.**

41 CMOS Connector — Input connector for CMOS sense voltage. When using CMOS circuitry, input the corresponding CMOS power supply through this connector to modify the 5006A trigger levels.

42 PROBE Connector — Test connector for the Data Probe during Operation Verification test procedure.

Figure 3-11. Front Panel Controls (Continued)



⚠

43 LINE INPUT — The ac power input connector. Accepts the input ac power cord. Protective grounding conductor connects to the instrument through this connector.

44 LINE SELECT SWITCH — Selects the instrument line voltage. The number visible on the switch indicates the nominal line voltage to which the instrument must be connected (see *Figure 2-1*). Selects either 115 or 230 volts ac.

45 LINE FUSE — The line fuse for the instrument. The fuse value should be 250 mAT for 115 volt operation, or 125 mAT for 230 volt operation.

46 HP-IB CONNECTOR (Shown in Photo) — HP-IB Interface Connector for remote operation via the HP-IB. Provided only with Option 040.

or

HP-IL CONNECTOR — HP-IL Interface Connector for remote operation via the HP-IL. Provided only with Option 030.

47 INTERFACE ADDRESS SWITCH — Interface address switch, contains switches A1 through A5 to select up to 31 (binary) addresses. Address 31(all switches to "1") selects the TALK-ONLY mode. Provided only with Option 030 or Option 040.

Figure 3-12. Rear Panel Features

3-96. REMOTE PROGRAMMING

3-97. Introduction

3-98. The 5006A Signature Analyzer (with Option 040) is compatible with the Hewlett-Packard Interface Bus (HP-IB), and (with Option 030) is compatible with the Hewlett-Packard Interface Loop (HP-IL). Remote programming allows the instrument to respond to remote control instructions and output measurement data via the interface. At the simplest level, the 5006A can output data in the talk only mode to other devices such as a controller or printer. In more sophisticated systems, a controller can remotely program the 5006A to perform a specific type of measurement, trigger the measurement, and output the results.

Note

HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1978, *"Standard Digital Interface for Programmable Instrumentation".*

3-99. The programming information in this section, except where noted, applies to both HP-IB and HP-IL interfaces. In general, the HP-IB may be considered a subset of HP-IL, as almost all capabilities of the HP-IB are also capabilities of the HP-IL. Every effort has been made to make the programming of the 5006A consistent, regardless of which interface is configured.

3-100. To remotely program the 5006A efficiently, the operator must be familiar with the selected controller, the configured interface, and the local (manual) operation of the 5006A. Typical controllers for the HP-IB are the 9825A/B, 9826A, 9830A, 9835/45A, or 85A. The typical controller for the HP-IL is the HP 41CV. Users of the HP-IB Interface should find the following manuals useful background information:

Condensed Description of the Hewlett-Packard Interface Bus(P/N 59401-90030)

HP-IB Programming Hints For Selected Instruments (P/N 59300-90005)

Tutorial Description of the Hewlett-Packard Interface Bus (P/N 5952-0156)

3-101. Users of the HP-IL interface may be unfamiliar with the HP-IL system. An introductory description of the interface system, and the Hewlett-Packard Interface Loop (HP-IL) is provided in paragraph 3-105. More detailed information on the HP-IL is available in the following publications:

HP-IL Interface Specification (P/N 82166-90017)

The HP-IL System: *An Introductory Guide to the Hewlett-Packard Interface Loop* (Published by OSBORNE/ McGraw-Hill, 630 Bancroft Way, Berkeley, CA 94710)

3-102. INTERFACE DESCRIPTION

3-103. Hewlett-Packard Interface Bus (HP-IB)

3-104. The Hewlett-Packard Interface Bus (HP-IB) system utilizes a party-line bus structure (devices share signal lines) to which a maximum of 15 devices may be connected in one contiguous bus. Sixteen signal lines and 8 ground lines are used to interconnect devices in a parallel arrangement and maintain an orderly flow of device and interface related information.

3-105. Hewlett-Packard Interface Loop (HP-IL)

3-106. The Hewlett-Packard Interface Loop (HP-IL) is a two-wire serial interface that provides programmable control of instruments while being easy to use and understand. The controller and all devices in the loop, including the 5006A, are connected together in series, forming a continuous loop communications circuit. Any information (instructions or data) that is transferred among HP-IL devices is passed from one device to the next around the loop (one direction only). If the information is not intended for a particular device, that device simply passes the information on to the next device in the loop. When the proper device receives the information, that device responds as directed. In this way, the controller or the 5006A can send information to and receive information from each device in the loop, according to the device's capability.

3-107. The 5006A may be connected anywhere in the interface loop. The loop consists of up to 30 devices plus the controller using simple addressing. When installing or removing the 5006A (or any other device) it is a good practice to turn off the controller first. Then simply disconnect the loop in one place and connect the 5006A at that point. Remember, the interface cables must form a continuous loop. All HP-IL connectors are designed to ensure proper orientation and indicate the direction of information transfer.

3-108. INTERFACE FUNCTIONAL OVERVIEW

3-109. Each device on the interface may possess one or more of the following major device capabilities: Controller, Talker, or Listener. The controller, as the name implies, has the responsibility to control inter-

face activity. The controller, of course, must be equipped with the proper interface module. Controllers transmit all device independent commands to other devices in the interface and usually have Talker and Listener capabilities. The 5006A cannot serve as a controller. Only one device in the interface may be the active controller at any one time.

3-110. Talkers are devices that have the ability to send data or device dependent commands through the interface. Note that a talker will not actually send its data or information until told to do so by the controller. The 5006A has Talker capabilities. When the 5006A is talking on the interface, its TALK annunciator will turn on. In special situations, one device may be classified as a Talk-only device and sends information to Listen-only devices. Such a system would not have a controller. For example, the 5006A can be configured for Talk-only mode and send measurement results to a printer.

3-111. Listeners are devices with the capability to receive information over the interface. When the 5006A is "listening", its LISTEN annunciator turns on. Listeners must also be enabled by the controller to receive the information.

3-112. INTERFACE SYSTEM TERMS

3-113. The following paragraphs define the terms and concepts used to describe HP-IB and HP-IL system operations.

a. Address: Each device in the interface is assigned an address. The address is used to specify which device on the interface will receive information or send information.

b. Byte: A byte is a unit of information consisting of 8 binary digits called bits.

c. Device: Any instrument or unit that is HP-IB or HP-IL compatible is called a device.

d. Device Dependent: An action a device performs in response to information sent through the interface. The action is characteristic of a particular instrument and will probably vary from device to device.

e. Device Independent Command: A command pre-defined by the interface standard to have a specified bit pattern and resulting action.

f. Device Dependent Command: A command not pre-defined by the interface standard, which is specific to a particular instrument or family of instruments. Device dependent commands are usually sent as ASCII strings of characters.

g. Frame: Messages sent through the HP-IL interface as a sequence of eleven bits are called a message "frame".

h. Polling: Polling is a process typically used by a controller to locate a device that has requested service from the controller. There are two types of polling, Serial Poll and Parallel Poll:

1. Serial Poll. When the controller executes a serial poll, the addressed device sends one byte of operational information called a status byte. If more than one device in the interface is capable of requesting service, each device on the interface must be serial polled until the device that requested service is located.

2. Parallel Poll. When the controller executes a parallel poll, all devices on the interface respond, each one setting or clearing a particular data bit to indicate whether or not it requested service.

3-114. ADDRESS SELECTION

3-115. Manual Addressing. To use the 5006A in a system, set the rear panel address switches to the desired address. Addresses 0 through 30 represent the addressable mode range. Address 31 selects the TALK ONLY mode. The addressable mode is used when the 5006A functions as a talker and listener. The TALK ONLY mode is employed when the 5006A is operating in an output-only condition (no controller on the bus) and sends its data to another device on the bus, such as a printer, set to LISTEN ALWAYS.

3-116. The five rightmost switches, A5 through A1, set the addresses of the 5006A. *Table 3-5* shows all possible address settings and the corresponding ASCII codes used by some controllers for talk and listen. The 5006A is factory set to address 10 as shown in *Figure 3-13.*

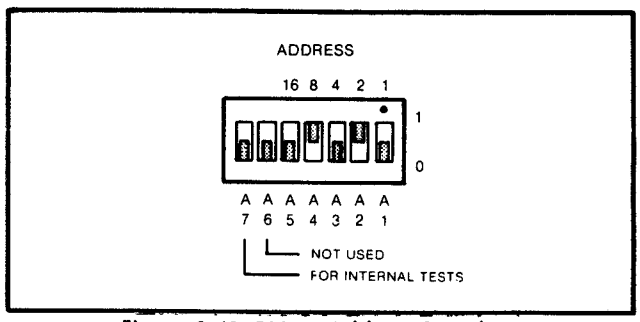
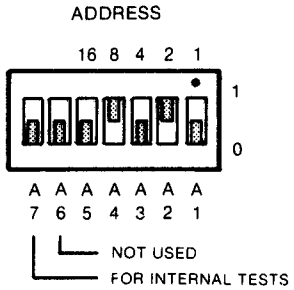


Figure 3-13. 5006A Address Switches

Table 3-5. Address Selection



(Shown in addressable mode, and address 10)

NOTE

Select the decimal listen address from the table below and set the address switches to the corresponding positions.

ASCII CODE CHARACTER		ADDRESS SWITCHES					5-BIT DECIMAL CODE
LISTEN	TALK	A_5	A_4	A_3	A_2	A_1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21*
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

*Address "21" is the preset controller address for HP controllers.

3-117. Auto-addressing. Auto-addressing is a method of setting the instrument's address, unique to HP-IL, and is provided by the HP85, 75, and 41. When auto-addressing is enabled, each device in the loop is assigned an address by the controller. The assigned address will probably be different than the factory preset address. The 5006A, for example, has a preset address of 10. If the 5006A is the only device in the loop with the controller, the controller will assign it an address of "1". The address permits the controller to specify or select a particular device in the loop when sending commands. As shown in *Figure 3-14,* addresses are assigned to particular devices sequentially around the loop in the direction of information flow. The first device after the controller is assigned an address of "1". The second device is assigned the address "2", and so on around the loop. The controller has an address of "0".

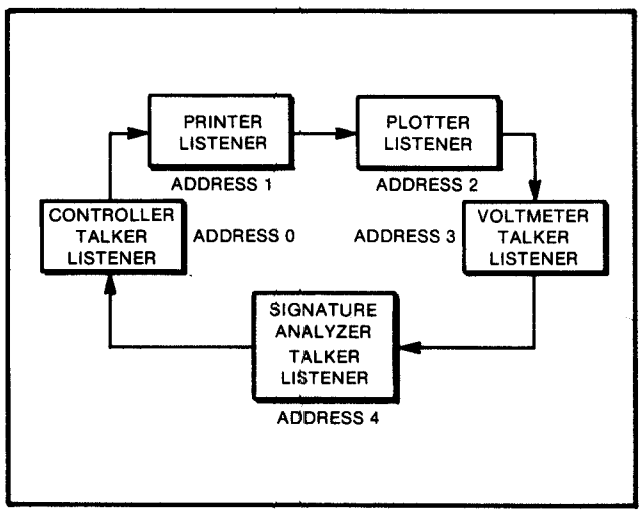


Figure 3-14. Typical HP-IL System Addressing

3-118. FRONT PANEL INTERFACE STATUS LEDS

3-119. The four Interface Status LEDs on the front panel indicate the remote status of the 5006A. The REMOTE LED lights to indicate that the 5006A is under remote control. The TALK LED lights to indicate that the 5006A is addressed to talk (send data). The LISTEN LED lights to indicate that the 5006A is addressed to listen (receive commands). The SRQ LED lights to indicate that a service request condition exists (as determined by a set service request mask bit).

3-120. When the 5006A returns from remote operation to the local mode, the REMOTE LED turns off. The TALK or LISTEN, and SRQ LEDs will remain in their current state. If the 5006A is unaddressed, the SRQ LED will remain in its current state. In the TALK ONLY mode, the TALK LED is always lighted.

3-121. INTERFACE FUNCTION

3-122. The capability of a device connected to the bus (or in the loop) is specified by its interface functions. These functions provide the means for a device to receive, process, and send messages over the interface. *Table 3-6* lists the 5006A interface functions using the terminology of the IEEE 488-1978 standard and of the HP-IL Interface Specification. These functions appear on the rear panel near the interface connector, as follows:

HP-IB SH1,AH1,T5,TE0,L4,LE0,SR1,RL1,
PP0,DC1,DT1,C0

HP-IL R,AH,SH1,D,L1,(T1,2,3,4,5)C0,DC2,DT1,
PP1,SR2,AA1,RL2,PD0,DD1

3-123. The number following the interface function code indicates the particular capability of that function.

Table 3-6. Interface Functions

Interface Function Subset Identifier	HP-IB Interface Function Description
SH1	Source handshake. Full capability.
AH1	Acceptor handshake. Full capability.
T5	Talker. Includes serial poll, talk-only, unaddress if my-listen-address (MLA) capabilities.
TE0	Extended talker. No capability.
L4	Listener. Includes unlisten if my-listen-address.
LE0	Extended listener. No capability.
SR1	Service request. Full capability.
RL1	Remote/local. Full capability.
PP0	Parallel poll. No capability.
DC1	Device clear. Full capability.
DT1	Device trigger. Full capability.
C0	Controller. No capability.

Table 3-6. Interface Functions (Continued)

Interface Function Subset Identifier	HP-IL Interface Function Description
R	Receiver. Full capability.
AH	Acceptor handshake. Full capability.
SH1	Source handshake. Full capability.
D	Driver. Full capability.
L1	Listener. Basic listener.
T1	Talker. Basic talker.
T2	Talker. Serial poll.
T3	Talker. Send device ID.
T4	Talker. Send accessory ID.
T5	Talker. Talk-only.
C0	Controller. No capability.
DC2	Device clear. Full capability.
DT1	Device trigger. Full capability.
PP1	Parallel poll. Full capability.
SR2	Service Request. Full capability.
AA1	Auto address. Simple addressing.
RL2	Remote local. Full capability.
PD0	Power down. No capability.
DD1	Device dependent commands. Full capability.

3-124. The 5006A can operate (as listed in *Table 3-6)* as both a talker and listener. The 5006A output format is the same regardless of the mode (talk only or addressable).

a. TALK. The 5006A can be addressed to Talk by a controller or by the TALK ONLY interface function. When addressed as a Talker, the 5006A will send data to other devices on the interface, depending on the function selected. The TALK ONLY function is selected by setting the interface address switches, located on the rear panel, to address "31".

b. LISTEN. When addressed as a Listener, the instrument will accept commands via the interface. These commands are used to program the instrument's operation.

c. SERVICE REQUEST (SRQ). SRQ can be sent active on the interface whenever an enabled status bit is set. The 5006A can also request service asynchronously from the controller. Refer to the "RMnnn" command described in paragraph 3-158.

d. REMOTE/LOCAL: On power up, the 5006A is under front panel (local) control. To program the 5006A, it must be placed in Remote. Once in Remote, programmable functions cannot be changed by front panel control. The LOCAL key may be used to return the 5006A to local control. This key may be disabled with the Local Lockout (LLO) command. In LLO, the interface command NRE (Not Remote Enable) must be sent to disable LLO and return the instrument to local operation.

e. PARALLEL POLL: The 5006A with HP-IB does not support parallel poll. The 5006A with HP-IL does support parallel poll.

f. DEVICE CLEAR: When a group or selected device clear is received, the instrument resets and clears the display.

h. DEVICE TRIGGER: When a device trigger is received, the 5006A flags the next measurement as a triggered measurement.

i. CONTROLLER: The 5006A cannot act as a controller.

3-125. INTERFACE COMMANDS

3-126. The commands that the HP5006A recognizes can be separated into two classes: device dependent commands and device independent commands. Device dependent commands are those that are unique to the instrument and are defined by the instrument designer. They are normally sent to an instrument as ASCII strings, as, for example, in the HP85 command OUTPUT 710; "FR1", which turns on the Recall function.

3-127. Device independent commands, on the other hand, are defined by the interface standard document and are the same in all instruments. These commands are identified by a three letter mnemonic such as GTL, which represents Go to Local. Device independent commands are sent as specially encoded bytes on

the interface and not as ASCII strings. Thus these commands cannot be sent using the OUTPUT statement on the HP85. However, many controllers do incorporate a command of the form SEND 7; CMD nnn, where nnn is the decimal equivalent to the bit pattern corresponding to a particular device independent command.

3-128. INTERFACE CAPABILITIES

3-129. Since the device independent commands are standardized and are the same in all instruments, the functions these commands perform can be listed on the instrument in a standardized manner. This is known as the interface capability label.

3-130. *Table 3-7* provides a list of the interface capabilities of the instrument.

3-131. DEVICE INDEPENDENT COMMANDS

3-132. *Table 3-8* provides a list of supported device independent command mnemonics. The command's full name, whether the command is used on HP-IB, HP-IL, or both, and a description of the function of the command.

Table 3-7. 5006A Interface Capabilities

HP-IB	HP-IL	Description
SH1	SH1	The instrument can generate messages.
AH1	AH	The instrument can interpret received messages.
	R	The instrument can receive messages.
	D	The instrument can drive the HP-IL loop.
T5	T12345	The instrument can function as a talker. In addition, it can operate as a Talker Only instrument and can respond to serial poll, send device ID, and send accessory ID.
TE0		The instrument cannot function as an extended talker.
L4	L1	The instrument can function as a listener. In addition, it will untalk itself if addressed as a listener.
LE0		The instrument cannot function as an extended listener.
SR1	SR2	The instrument can generate a service request. In addition, the instrument can generate an IDY frame on HP-IL.
RL1	RL2	The instrument can operate in both remote and local modes. In addition, it can respond to local lockout.
PP0	PP1	The instrument does not support parallel poll on HP-IB. On HP-IL, the instrument does support parallel poll.
DC1	DC2	The instrument supports both the device clear (DCL) and selected device clear (SDC) commands.
DT1	DT1	The instrument can be remotely triggered.
C0	C0	The instrument cannot function as a controller.
	AA1	The instrument can be remotely addressed with simple (non-extended) addresses.
	PD0	The instrument cannot be remotely powered down.
	DD1	The instrument responds to the device dependent listener (DDL) command.

Table 3-8. 5006A Device Independent Commands

Mnem	HP-IB	HP-IL	Name
AAD n		X	Auto Address n
AAU		X	Auto Address Unconfigure
ATN	X		Attention (See Note 1)*
DCL	X	X	Device Clear
DDL n		X	Device Dependent Listener
EAR		X	Enable Asynchronous Request
EOI	X		End or Identify (See Note 1)*
ETE		X	End of Transmission, error
ETO		X	End of Transmission, OK
GET	X	X	Group Execute Trigger
GTL	X	X	Go To Local
IAA		X	Illegal Auto Address
IDY	X	X	Identify
IFC	X	X	Interface Clear (See Note 1)*
LAD n	X	X	Listen Address n
LLO	X	X	Local Lockout
MLA	X	X	My Listen Address
MTA	X	X	My Talk Address
NOP		X	No Operation
NRD		X	Not Ready for Data
NRE	X	X	Not Remote Enable (see Note 1)*
NULL	X	X	Null
PPD		X	Parallel poll disable
PPE n		X	Parallel poll enable
PPU		X	Parallel poll unconfigure
REN	X	X	Remote Enable (See Note 1)*
RFC		X	Ready For Command
SAI		X	Send Accessory Identification
SDA		X	Send Data
SDC	X	X	Selected Device Clear
SDI		X	Send Device Identification
SPD	X		Serial Poll Disable
SPE	X		Serial Poll Enable
SST		X	Send Status
TAD n	X	X	Talk Address n
UNL	X	X	Unlisten
UNT	X	X	Untalk

**Note 1: These messages are sent on single lines on HP-IB, rather than as complete bytes.*

3-133. The response of the instrument to the device independent messages is listed below:

AAD n — The instrument accepts n as its address, then transmits ADD (n+1) to the next instrument on the loop.

AAU — The instrument's address returns to the power-up default set by the rear panel switch.

ATN — Alerts the instrument that a device independent message is coming.

DCL — If the instrument is not in an error state, this command aborts the current measurement, aborts all pending send data commands, resets the gate state machine, and clears the composite signature, signature memory, and unstable LED. This is equivalent to the front panel clear button.

DDL n — If the instrument is a listener and is not currently auto-addressed, the auto-address function in the instrument will be disabled if n=0 and enabled if n=1. This command allows the instrument using HP-IL to more closely resemble one using HP-IB, as with auto-addressing disabled the instrument will always use the address set by the rear panel switches. The user should note that disabled auto-addressing is an abnormal state of the instrument and should only be used with caution.

EAR — The instrument is enabled to source an IDY frame when it requires service.

EOI — If Attention is false and the instrument is a listener, EOI acts as a message delimiter.

ETE — No effect when received by the instrument.

ETO — No effect when received by the instrument.

GET — If the instrument is addressed to listen, GET causes the next measurement to be a triggered measurement. This is equivalent to pressing the Data Probe switch.

GTL — If the instrument is addressed to listen, GTL causes the instrument to go to its local state. Local lockout is not cleared.

IAA — No effect when received by the instrument.

IDY — The instrument includes its parallel poll status bit in IDY command and retransmits it.

IFC — The instrument untalks and unlistens.

LAD n — If n matches the instruments address, the instrument becomes a listener.

LLO — The front panel Clear/Local key is disabled.

MLA — MLA is that particular LAD n for which n matches the instrument address.

MTA — MTA is that particular TAD n for which n matches the instrument address.

NOP — Asynchronous service requests are disabled.

NRD — The instrument stops sending data until an SDA is received.

NRE — The instrument goes to local and local lockout is cleared.

NUL — No effect when received by the instrument.

PPD — If the instrument is a listener, parallel poll is disabled.

PPE n — Parallel poll is enabled. The instrument uses n to determine the proper parallel poll response.

PPU — Parallel poll is disabled whether or not the instrument is a listener.

REN — The instrument is enabled to enter the remote state on the next addressing as a listener.

RFC — The instrument holds the RFC byte until ready for the next command.

SAI — The instrument sends the number 81 in binary. This identifies the instrument as an instrument with measurement or detection capabilities.

SDA — The instrument sends a data message.

SDC — If the instrument is a listener, SDC will cause the same response as DCL.

SDI — The instrument sends the string "HP5006A" to identify itself.

SPD — Disables serial polling.

SPE — Enables serial poll and causes the instrument to send its serial poll status byte.

SST — The instrument sends its serial poll status byte.

TAD n — If n matches the instrument address, the instrument becomes a talker.

UNL — The instrument ceases to be a listener.

UNT — The instrument ceases to be a talker.

3-134. META MESSAGES

3-135. In order to simplify the use of the HP-IB and HP-IL interfaces, HP has developed what is called the Meta Messages concept. Rather than requiring the user to remember all the device independent messages and their interactions, useful sequences of these commands have been integrated into a single command on many of HP's controllers. For example, to clear the the instrument at address 10 using the device independent commands, it is necessary to send the sequence ATN, UNL, MTA, LAD 10, SDC. In the HP85, the command CLEAR 710 causes this sequence to be sent with no further user interaction. This greatly simplifies the use of the interface.

3-136. Many of the meta messages as implemented on the HP85 may be sent in either of two forms, either with or without addressing. The form with addressing

will normally listen address the instrument. For example, the command REMOTE 7 will send a REN without making any instrument a listener, while the command REMOTE 710 will send REN and then make the instrument a listener. In the following tables, the form with addressing is shown.

3-137. *Table* 3-9 lists the meta messages, their results in the HP5006A, and typical interface message sequences corresponding to them. The sequences are typical in that different controllers may send different sequences, while still obtaining the same results.

Table 3-9. Meta Messages

Message	Description/Response
DATA	A means to send device dependent commands and receive measurement data. HP-IB: [UNL, MTA, LADn, data] HP-IL: [UNL, MTA, LADn, SDA, data]
TRIGGER	Will cause the next measurement to be a triggered measurement. [UNL, MTA, LADn, GET]
CLEAR	Will clear the display, composite signature, memory, unstable LED, and gate state machine if not in error state. If in error state, clears error only. [UNL, MTA, LADn, SDC]
REMOTE	Disables front panel keys (except for Clear/Local). [REN, UNL, MTA, LADn]
LOCAL	Enables the front panel keys. [UNL, MTA, LADn, GTL]
LOCAL AND CLEAR LOCKOUT	Enables the front panel keys and clear local lockout. [NRE]
LOCAL LOCKOUT	Disables the Clear/Local key when in remote. [LLO]
SERVICE REQUEST	This command is ignored when received by the instrument. It will be sent by the instrument when an enabled service condition is present.
STATUS BYTE	Presents status information. HP-IB: [UNL, MLA, TADn, SPE, data, SPD, UNT] HP-IL: [UNL, MLA, TADn, SST, data, UNT]
STATUS BIT	Single bit parallel poll response indicates whether this instrument is requesting service. [IDY]
PASS CONTROL	Not supported.
ABORT	Terminates bus communications by unlistening and untalking all instruments. [IFC]
DEVICE ID	Causes the instrument to send the string "HP5006A". [UNL, MLA, TADn, SDI, data]
ACCESSORY ID	Causes the instrument to send the number 81 in binary. This identifies the instrument as a measuring instrument. [UNL, MLA, TADn, SAI, data]

3-138. *Table 3-10* lists the meta messages and the HP9825, HP85, and HP41C commands that correspond to them. (Only the addressed form is shown for the commands that support both the unaddressed and addressed forms. The HP41C requires the address selection to be made using a SELECT statement). The table assumes the instrument is set to address 10 and the interface to select code 7.

3-139. SRQ, SRQ MASK, AND STATUS BYTE

3-140. When in remote operation, the 5006A can send a service request (SRQ) to the controller under any, all, or none of the following conditions, as defined by the Service Request Mask. The Service Request Mask (RM command, see paragraph 3-158) must be set prior to the condition.

1. Data ready. A measurement has been completed and is available for collection.

2. Trigger Occurred. The Data Probe switch has been pressed, after the ST command was sent. Pressing the Data Probe switch selects the next measurement as a "triggered" measurement.

3. Error or Fail. An Error or Failure condition exists, and is displayed.

4. Local. Instrument is in local.

3-141. In general, the controller can read the 5006A Status Byte at any time to check selected operating conditions. During remote operation, you may selectively program the 5006A Service Request Mask (RMnnn) to identify the conditions which you feel may require service or data collection.

3-142. Once SRQ has been sent, the controller can identify which condition or conditions caused the Service Request by reading the Status Byte. When the Status Byte is read, conditions that have occurred since the last clear will be set to 1 whether or not enabled as a condition to generate SRQ. Sending a "rds (710)" with the 9825A, or "A=SPOLL (710)" with the 85A requests the eight-bit binary Status Byte. The number returned will be a decimal equivalent to the sum of the different status bits set, as shown in *Table 3-11*.

Table 3-10. Meta Messages and Controller Commands

Message	HP9825	HP85	HP41C
DATA	wrt 710; A$ red 710; A$	OUTPUT 710; A$ ENTER 710; A$	OUTA INA
TRIGGER	trg 710	TRIGGER 710	TRIGGER
CLEAR	clr 710	CLEAR 710	
REMOTE	rem 710	REMOTE 710	REMOTE
LOCAL	lcl 710	LOCAL 710	LOCAL
LOCAL/CLEAR LOCKOUT	lcl 7	LOCAL 7	
LOCKOUT	llo 7	LOCAL LOCKOUT 7	
SERVICE REQUEST		STATUS 7,1; A	
STATUS BYTE	rds (710)	SPOLL (710)	INSTAT
STATUS BIT		PPOLL (7)	
PASS CONTROL			
ABORT	cli 7	ABORTIO 7	STOPIO
DEVICE ID		SEND 7; CMD 255	FINDID
ACCESSORY ID		SEND 7; CMD 254	

Table 3-11. HP5006A Status Byte

D7	D6	D5	D4	D3	D2	D1	D0
0	SRQ FLAG	POWER ON	LOCAL	0	ERROR or FAIL	TRIGGER OCCURRED	DATA READY
128	64	32	16	8	4	2	1

3-143. For example; the instrument requested service (SRQ) and a reading of the Status Byte returned a value of "99". This can be interpreted as 64 + 32 + 2 + 1 = 99, meaning the SRQ FLAG is set, power is on, a trigger (data probe switch) occurred, and data is ready. The bits of the status byte are set regardless of the service request mask, however, if that bit is masked out, it will not generate an SRQ.

3-144. DEVICE DEPENDENT COMMANDS

3-145. Input Format

3-146. The 5006A will accept command strings in either upper or lower case. Spaces and commas between commands are ignored. Semicolons are interpreted as command terminators. In addition, parity bits will be ignored. Depending upon the controller, this can help to speed up programming. The following command statements will produce identical results:

```
OUTPUT 710; "FQ1,FS1,FU1,PC2,PT2,PP2,PQ1"

output 710; "fq1,fs1,fu1,pc2,pt2,pp2,pq1"
```

3-147. Command Descriptions

3-148. All local functions are programmable with individual command codes via the interface. In general, all functions operate the same in remote as in local. The 5006A commands are described in the following paragraphs and listed in *Table 3-12.*

3-149. The listed command set contains several commands which may appear redundant in function or unrelated to the 5006A (i.e.; F0, F1, and RS). Many of these commands have been included simply to provide programming compatibility with the 5005B Signature Analyzer.

3-150. The following paragraphs describe the programmable function and polarity commands for the 5006A. Bold type denotes the default states assumed on power up.

3-151. Function Commands

FRn RECALL
FR0 = RECALL function disabled.
FR1 = RECALL function enabled.

FEn EDIT
FE0 = EDIT function disabled.
FE1 = EDIT function enabled.

FSn SIG LATCH
FS0 = SIGNATURE LATCH function disabled.
FS1 = SIGNATURE LATCH function enabled.

FUn UNSTABLE LATCH
FU0 = UNSTABLE LATCH function disabled.
FU1 = UNSTABLE LATCH function enabled.

FQn QUAL
FQ0 = Clock QUALified function disabled.
FQ1 = Clock QUALified function enabled.

3-152. Polarity Commands

PCn CLOCK POLARITY Select
PC1 = Clock triggers on rising edge of signal.
PC2 = Clock triggers on falling edge of signal.

PTn START POLARITY Select
PT1 = Start triggers on rising edge of signal.
PT2 = Start triggers on falling edge of signal.

PPn STOP POLARITY Select
PP1 = Stop triggers on rising edge of signal.
PP2 = Stop triggers on falling edge of signal.

PQn QUAL POLARITY Select
PQ1 = Qualify set to active high level.
PQ2 = Qualify set to active low level.

3-153. SEND DATA COMMANDS

3-154. Measurement Triggering in Remote (Default Mode)

3-155. The 5006A (with no latch Functions enabled) normally operates in a free-run status, with the instrument self-armed. When proper Start, Stop, and Clock inputs are connected, the 5006A will take measurements continuously, with the latest completed data available to the interface after the measurement is completed. As data becomes available, it does not automatically transfer to the controller unless specifically requested, and is normally replaced after the next measurement is completed. If the controller sends the command "GET" or the operator presses the Data Probe switch, the next measurement will be a triggered measurement. When the controller sends a "Send Data" command, the specific action is performed, then on the next measurement cycle the 5006A returns to its default condition of continuous measurements.

3-156. Command Descriptions

3-157. The following paragraphs describe the send data commands for the 5006A. Sending one of the following commands will cause the 5006A to respond by returning the requested data, then return to the previous state. The receipt of any device dependent command will abort any pending send data command and cause the instrument to revert to the continuous measurement mode.

SE Send Error Code

Causes the 5006A to send the error code to the controller. This code is the two digit decimal number which corresponds to the error or failure condition, as shown in *Table 3-1*. If no failure has occurred, the error code returned will be "00".

SI Send Device Identification

Causes the 5006A to respond with "HP5006A CR LF". This command is useful for ascertaining the address of the 5006A or for determining which instrument has been assigned to a particular address.

SL1 Send Logic Probe Current State

Causes the 5006A to send the current state of the Logic Probe. Upon receipt of the Send Logic Probe State command, the instrument will send out one of the following messages; HI, LO, PU, or FL. The message corresponds to the current logic probe indication as follows: (HI) High, (LO) Low, (PU) Pulsing, or (FL) Floating.

SL2 Send Logic Probe Triggered States

Causes the 5006A to send a summary of the Logic Probe states which occur during the next triggered gate cycle. Upon receipt of the Send Logic Probe Triggered command, the instrument will cease sending signatures and will wait for a trigger. Once a trigger is received, the instrument will look for highs and lows at the data probe. When the end of the gate interval is detected the instrument will send out one of the following messages; HI, LO, PU, or FL. The message corresponds to the logic probe indications which occurred during the triggered gate cycle as follows: (HI) Highs but no Lows occurred, (LO) Lows but no Highs occurred, (PU) both Lows and Highs occurred, or (FL) neither High nor Low occurred.

SP Send Polarities

Causes the 5006A to send the current state of the polarities. Upon receipt of the Send Polarities command, the instrument will send a decimal number, corresponding to the sum of the binary weights of the polarity bits set as follows:

Bit	Meaning	Weight
Bit7	Always 0	128
Bit6	Always 0	64
Bit5	Qualifier Level (1=HI)	32
Bit4	Qualifier Enable (1=Enabled)	16
Bit3	Always 0	8
Bit2	Stop Edge (1=rising)	4
Bit1	Start Edge (1=rising)	2
Bit0	Clock Edge (1=rising)	1

For example, if QUAL Function was enabled and the QUAL level set to HI and the Stop, Start, and Clock edges were set to rising, the 5006A would return the decimal number "55". This represents the sum of the set bits (32 + 16 + 4 + 2 + 1).

The intent of this function is to allow a controller to store the state of the instrument temporarily so as to return it to that state at a later time. The data is not intended for user interpretation.

SS1 Send Triggered Signature

Causes the 5006A to send the next triggered signature. A triggered signature is the first complete signature which follows a trigger from either the Data Probe switch or the GET command.

If the instrument is operating as a talker, it will normally transmit all signatures as available to be sent to the interface. The Send Triggered Signature command inhibits the instrument from sending signatures until a triggered signature is received. Once a triggered measurement has been sent, the instrument returns to its normal mode of sending all signatures.

SS2 Send Unstable Signature

Causes the 5006A to send the next unstable signature.

If the instrument is operating as a talker, it will normally transmit all signatures as available to be sent to the interface. The Send Unstable Signature command inhibits the instrument from sending signatures until an unstable signature is taken. Once an unstable measurement has been sent, the instrument returns to its normal mode of sending all signatures.

ST Send Trigger Bit

Causes the 5006A to set the triggered bit (Bit 1) in the status byte when a triggered measurement occurs.

3-158. Receive Data Commands

3-159. The following paragraphs describe the receive data command codes for the 5006A.

RAnnn Receive Digit A Display Data

Upon receipt of the RAnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "A" digit of the display.

RBnnn Receive Digit B Display Data

Upon receipt of the RBnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "B" digit of the display.

RCnnn Receive Digit C Display Data

Upon receipt of the RCnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "C" digit of the display.

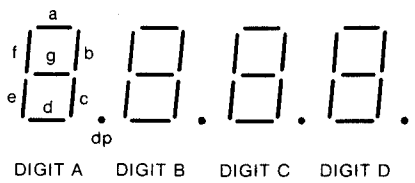
RDnnn Receive Digit D Display Data

Upon receipt of the RDnnn command, the instrument will load the binary value of "nnn" into the register corresponding to the "D" digit of the display.

For each of the Receive Digit commands (RA, RB, RC, RD) the binary value of "nnn" is interpreted as follows:

BIT	MEANING	WEIGHT
Bit7	Segment decimal point	128
Bit6	Segment a	64
Bit5	Segment b	32
Bit4	Segment c	16
Bit3	Segment d	8
Bit2	Segment e	4
Bit1	Segment f	2
Bit0	Segment g	1

For example, if the instrument received the command "RA255" display digit A register would be loaded with the value "255". The value, interpreted as 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1, would enable all the segments and decimal point in digit A (leftmost digit in display).
The assignment of display digits and digit segments is as follows:



RMnnn Receive Service Request Mask

Upon receipt of the RMnnn command, the instrument will load the binary value of "nnn" into the service request mask register. The SRQ/line bit will be set if a bit in the status byte becomes set and the corresponding bit in the service request mask is set. To specify the service request mask, send the RM command followed by a decimal number representative of the binary sum of the bits that you want enabled. Only the five LSB can be masked or unmasked. You may send any number between 0 and 255, although only the five least significant bits are used. The binary value of "nnn" is interpreted as follows:

	BIT	MEANING	WEIGHT
Not Maskable	Bit7	Always 0	128
	Bit6	SRQ	64
	Bit5	Power On	32
Maskable Bits	Bit4	Instrument in Local	16
	Bit3	Always 0	8
	Bit2	Error or Fail Condition	4
	Bit1	Trigger occurred after ST command	2
	Bit0	Data Ready	1

For example, sending the command "RM7" will generate a service request (SRQ) after; an Error or Fail condition or a trigger occurred or data is ready (4 + 2 + 1). Sending the command "RM0" masks off (or disables) all SRQ conditions. The condition or conditions which caused the service request may be determined by reading the Status Byte.

RPnnn Receive Data to Write to Polarities

Upon receipt of the RPnnn command the instrument will load the binary value of "nnn" into the polarity register. The binary value of "nnn" is interpreted as follows:

BIT	MEANING	WEIGHT
Bit7	Always 0	128
Bit6	Always 0	64
Bit5	Qualifier Level HI	32
Bit4	QUALIFY FUNCTION	16
Bit3	Always 0	8
Bit2	Stop Edge Rising	4
Bit1	Start Edge Rising	2
Bit0	Clock Edge Rising	1

Although each of the Polarity states can be programmed individually, via each keys unique command (PC1, PC2, etc.) the RPnnn command allows all of the Polarity settings to be specified in one command. This is particularly useful in conjunction with the SP command. These two together allow a polarity setup to be stored in the controller and later re-established.

You should also be aware of the interactive relationship of the QUALIFY Function and Qualify level within this command. If your RP command does not set the QUALIFY FUNCTION (16), no QUALIFY level will be set. To set the QUALIFY FUNCTION on and QUALIFY level LOW, send "16"; to set the QUALIFY FUNCTION on and QUALIFY level HI, send "48". For example, if the instrument received the command "RP55", the polarity register would be loaded with the value "55". The value, interpreted as 32 + 16 + 4 + 2 + 1, would enable the Clock QUALIFY FUNCTION and set the QUAL level to HI, the Stop, Start, and Clock edges to rising.

3-160. Other Device Dependent Commands

3-161. The following paragraphs describe additional device dependent commands. These commands are included to ensure programming compatibility with other remote programmable signature analyzers, such as the HP5005B.

RS Reset

RS. This command is equivalent to FR0, FE0, FS0, FU0, FQ0, PC1, PT1, PP1, PQ0.

PSn Probe Switch Enable

PS0. Upon receipt of the PS0 command, the instrument sets the RECALL, EDIT, SIG LATCH, and UNSTABLE LATCH functions to the disabled state (FR0, FE0, FS0, FU0), then clears the SS1 and SS2 commands and resets the gate control state machine.
PS1. Upon receipt of the PS1 command, the instrument sets the RECALL, EDIT, SIG LATCH, and UNSTABLE LATCH functions to be disabled state (FR0, FE0, FS0, FU0), then sets the SS1 command and resets the gate control state machine.

Fn HP5005B Compatible Function

F0. Upon receipt of the F0 command, the instrument sets the RECALL, EDIT, SIG LATCH, UNSTABLE LATCH, and QUAL functions to the disabled state (FR0, FE0, FS0, FU0, FQ0).
F1. Upon receipt of the F1 command, the instrument sets the RECALL, EDIT, SIG LATCH, UNSTABLE LATCH functions to the disable state and sets the QUAL function to the enabled state (FR0, FE0, FS0, FU0, FQ1).

ID Device Identification

ID. This command is identical to the Send Device Identification command (SI). It causes the 5006A to respond with "HP5006A CR LF".

QMn Service Request Mask

QMn. This command is identical to the Receive Service Request Mask command (RMn).

SMn Set Service Request Mask

SMn. This command is identical to the Receive Service Request Mask command (RMn).

Table 3-12. Instrument Program Command Set

FUNCTION SELECT COMMANDS	
*F0	Function Signature Analysis NORM (FR0,FE0,FS0,FU0,FQ0)
*F1	Function Signature Analysis QUAL (FR0,FE0,FS0,FU0,FQ1)
FR0	Function Recall Disable
FR1	Function Recall Enable
FE0	Function Edit Disable
FE1	Function Edit Enable
FS0	Function Signature Latch Disable
FS1	Function Signature Latch Enable
FU0	Function Unstable Latch Disable
FU1	Function Unstable Latch Enable
FQ0	Function Qualifier Disable
FQ1	Function Qualifier Enable
*RS	Send Reset
POLARITY SELECT COMMANDS	
PC1	Set CLOCK to Rising Edge
PC2	Set CLOCK to Falling Edge
PT1	Set START to Rising Edge
PT2	Set START to Falling Edge
PP1	Set STOP to Rising Edge
PP2	Set STOP to Falling Edge
PQ1	Set QUAL to HI Level
PQ2	Set QUAL to LO Level
DATA PROBE SWITCH COMMANDS	
*PS0	Data Probe Switch Disable (FR0,FE0,FS0,FU0)
*PS1	Data Probe Switch Enable (FR0,FE0,FS0,FU0,SS1)
SEND DATA COMMANDS	
SS1	Send next Triggered Signature
SS2	Send next Unstable Signature
SL1	Send Logic Status/Current State
SL2	Send Logic Status/Triggered State
SE	Send Error
SP	Send Polarities
SI	Send ID
*ID	Send ID
ST	Send Trigger Bit
RECEIVE DATA COMMANDS	
RPnn	Receive Polarities
RAnnn	Receive Display Digit A
RBnnn	Receive Display Digit B
RCnnn	Receive Display Digit C
RDnnn	Receive Display Digit D
RMnnn	Receive Service Request Mask
*QMnnn	Receive Service Request Mask
*SMnnn	Receive Service Request Mask

*Note: These commands are included to ensure programming compatibility with other remote programmable signature analyzers, such as HP5005B.

3-162. PROGRAMMING EXAMPLES

3-163. The following examples demonstrate programming capabilities of the 5006A. The examples are written for the HP85A controller. A summary of the program operation and a line-by-line description are provided for each example.

EX1 Initializing the Front Panel
EX2 Sending a Signature to the Controller
EX3 Displaying the Contents of the Status Byte
EX4 Displays User Message on 5006 Display
EX5 Collects and displays accumulated signatures on controller
EX6 Reads the Logic Probe Status

3-164. The examples listed in this section assume a 5006A address setting of "10" (Address switches to "01010"). The 5006A is addressed to talk and listen by using the code "710" where "10" is the 5006A address and "7" is the interface select code. The ASCII characters for the same switch settings are "J" for a talk address and "*" for a listen address. These characters would be used if the controller were an HP9830A calculator (or 9825A/B when using the "cmd" statement).

EXAMPLE 1. INITIALIZING FRONT PANEL

The following example demonstrates how to initialize the front panel of the 5006A. The program clears the 5006A, then requests the instrument identification. The response is read into "A$", which is then displayed. The program sends the a command string which sets all functions to their "0" or inactive (default) states. The following command "RP7", sets the Clock, Start, and Stop Polarities to "rising".

```
10 CLEAR 710
20 OUTPUT 710 ;"ID"
30 ENTER 710 ; A$
40 DISP A$
50 OUTPUT 710 ;"FE0,FR0,FS0,FU0
   ,F00"
60 OUTPUT 710 ;"RP7"
70 END
```

LINE 10: Clears the 5006A at address 10.
LINE 20: Send "ID" command to 5006A. The ID command requests an instrument to return its identification; the 5006A will return "HP5006A CR".
LINE 30: Read 5006A "ID" response into A$.
LINE 40: Display contents of A$.
LINE 50: Set all functions to "0".
LINE 60: Set all polarities to "rising".
LINE 70: End program execution.

EXAMPLE 2. SEND SIGNATURE TO CONTROLLER

The following example sends the "SS1" send data command to the 5006A. This command causes the 5006A to send the next triggered signature. A triggered signature is the first complete signature after pressing the Data Probe switch. The controller loops through a serial poll step until the value of the DATA READY bit (LSB) of the status byte is not zero, indicating a triggered signature was taken and is ready to send. The signature data is entered into "A$", then displayed on the HP85 screen, with a beep. The program then repeats.

```
10 CLEAR
20 DISP "PROBE MODE, PRESS PROB
   E SWITCH  TO STORE SIGNATURE
    IN CONTROLLERDISPLAY"
30 OUTPUT 710 ;"SS1"
40 S=SPOLL(710)
50 IF BIT(S,0)=0 THEN GOTO 40
60 ENTER 710 ; A$
70 DISP A$
80 BEEP
90 GOTO 30
100 END
```

LINE 10: Clears the HP85 display.
LINE 20: Display operator prompt message.
LINE 30: Send "SS1" command to 5006A. The SS1 command sends the next triggered signature back over the interface.
LINE 40: Read the status of 5006A by a serial poll at address 10.
LINE 50: If value of bit Ø of the status byte is "0" (no data ready), then loop back to line 40.
LINE 60: Read 5006A status response into A$.
LINE 70: Display contents of A$.
LINE 80: Beep.
LINE 90: Return to line 30.
LINE 100: End program execution.

EXAMPLE 3. DISPLAY CONTENTS OF STATUS BYTE

The following example reads the status byte of the 5006A by a serial poll at address 10. The value returned is input into "A". The program then displays the meaning of each bit and the corresponding value returned in the status byte.

```
10 A=SPOLL(710)
20 DISP "REQUEST SERVICE
        =";BIT(A,6)
30 DISP "POWER-UP
        =";BIT(A,5)
40 DISP "INSTRUMENT IN LOCAL ST
   ATE  =";BIT(A,4)
50 DISP "ERROR OR FAILURE OCCUR
   ED   =";BIT(A,2)
60 DISP "TRIGGER AFTER ST COMMA
   ND   =";BIT(A,1)
70 DISP "DATA READY
        =";BIT(A,0)
80 END
```

LINE 10: Read the status of 5006A (into A) by a serial poll at address 10.
LINE 20: Display "REQUEST SERVICE=" followed by the value of bit 6 of status byte.
LINE 30: Display "POWER-UP=" followed by the value of bit 5 of status byte.
LINE 40: Display "INSTRUMENT IN LOCAL STATE=" followed by the value of bit 4 of status byte.
LINE 50: Display "ERROR OR FAILURE OCCURRED=" followed by the value of bit 2 of status byte.
LINE 60: Display "TRIGGER AFTER ST COMMAND= followed by the value of bit 1 of status byte.
LINE 70: Display "DATA READY=" followed by the value of bit 0 of status byte.
LINE 80: End program execution.

Running the program produces a display similar to the following:

```
REQUEST SERVICE                = 0
POWER-UP                       = 1
INSTRUMENT IN LOCAL STATE      = 0
ERROR OR FAILURE OCCURED       = 0
TRIGGER AFTER ST COMMAND       = 0
DATA READY                     = 1
```

EXAMPLE 4. SENDING TO THE 5006A DISPLAY

The following example demonstrates how to program the segments of the 5006A display digits, to generate a unique message. This function may be used interactively during a program to guide the operator with a specific instruction or response.

```
10 OUTPUT 710 ;"FS1"
20 OUTPUT 710 ;"RA123RB29RC15RD
   29"
30 WAIT 3000
40 OUTPUT 710 ;"RA109RB223RC126
   RD91"
50 WAIT 3000
60 OUTPUT 710 ;"FS0"
70 END
```

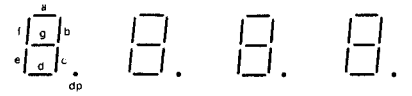
LINE 10: Send "FS1" command to 5006A. The FS1 command activates the Signature Latch function.
LINE 20: Send display data for the four display digits generating the message "goto".
LINE 30: Wait three seconds.
LINE 40: Send display data for the four display digits generating the message "26.05".
LINE 50: Wait three seconds.
LINE 60: Send "FS0" command to 5006A. The FS0 command disables the Signature Latch function.
LINE 70: End program execution.

The program begins by sending the command "FS1" which enables the Signature Latch function. The Signature Latch function latches the display data until it is replaced by new triggered data. This allows the unique displays to remain displayed for a length of time specified by WAIT statements. The command strings in lines 20 and 40 specify the segments of each digit (A, B, C, D) to be lighted. The 5006A interprets the decimal number following each digit data command (e.g. RA123) as a binary value corresponding to the segments of the digit as follows:

BIT	MEANING	WEIGHT	
Bit7	Segment decimal point	128	
Bit6	Segment a	64	64
Bit5	Segment b	32	32
Bit4	Segment c	16	16
Bit3	Segment d	8	8
Bit2	Segment e	4	---
Bit1	Segment f	2	2
Bit0	Segment g	1	1
			123

The command code "RA123" lights the a, b, c, d, f, and g segments of display A. The remaining commands are intrepeted in a similar fashion, and produce a display of "goto". After a three second wait the sequence is repeated, to display "26.05". The display "26.05" may be used to identify the circuit node location U26, pin 5.

The assignment of display digits and digit segments is as follows:



EXAMPLE 5. STORE, RECALL AND EDIT SIGNATURE MEMORY

The following example sets the 5006A up to take signatures when the Data Probe switch is pressed. The HP85 display prompts when a signature may be taken. As signatures are taken, they are entered into the signature memory and displayed on the HP85 screen. The HP85 also displays the programmed softkey labels, which allow the operator to select the RECALL function. During RECALL, the signature memory may be reviewed with SCAN or modified with EDIT. The signature memory reference number for any stored signature is not accessable directly. In this example, the reference number is computed using values stored in an internal addressable RAM, and then displayed on the HP85 screen.

```
  5 DIM A$[4]
 10 C=0
 20 ON KEY# 1,"RECALL" GOTO 170
 30 CLEAR
 40 KEY LABEL
 50 DISP ,"PRESS PROBE SWITCH TO
    STORE     SIGNATURES"
 60 DISP
 70 CLEAR 710
 80 OUTPUT 710 ;"F0"
 90 WAIT 500
100 OUTPUT 710 ;"SS1"
110 S=SPOLL(710)
120 IF BIT(S,0)=0 THEN GOTO 110
```

LINE 05: Dimension A string variable to 4 characters.

LINE 10: Initialize variable C; set value to "0".

LINE 20: Assign K1 softkey label; "RECALL". If K1 is pressed, program goes to 170.

LINE 30: Clears the HP85 display.

LINE 40: Displays the softkey labels.

LINE 50: Displays the operator prompt message "PRESS PROBE SWITCH TO STORE SIGNATURES".

LINE 60: Generates CR and LF for cursor.

LINE 70: Clears the 5006A at address 10.

LINE 80: Send "F0" command to 5006A, which sets all functions to off.

LINE 90: Wait 500 msecs.

LINE 100: Send "SS1" command to 5006A, which sends the next triggered signature.

LINE 110: Read the status of 5006A by a serial poll at address 10.

LINE 120: If value of bit 0 of the status byte is "0" (no data ready), then loop back to line 110.

```
130 ENTER 710 ; A$
140 BEEP
150 DISP A$
160 GOTO 90
170 OUTPUT 710 ;"FR1"
180 ENTER 710 ; A$
190 CLEAR
200 KEY LABEL
210 DISP ;"COMPOSITE SIGNATURE
    ";A$
220 IF C=1 THEN GOTO 290
230 ON KEY# 1,"SCAN" GOTO 280
240 ON KEY# 2,"EDIT" GOTO 380
250 KEY LABEL
260 ON KEY# 1,"SCAN" GOTO 280
270 GOTO 260
280 IF C=1 THEN GOTO 170
290 TRIGGER 710
300 ENTER 710 ; A$
310 OUTPUT 710 ;"SR35"
320 ENTER 710 ; A
330 OUTPUT 710 ;"SR28"
340 ENTER 710 ; B
350 C=A/2+B+1
360 DISP ;C;" ";A$
370 GOTO 260
380 OUTPUT 710 ;"FE1"
390 DISP ;"TAKE A NEW SIGNATURE"
400 OUTPUT 710 ;"SS1"
410 S=SPOLL(710)
420 IF BIT(S,0)=0 THEN GOTO 410
430 OUTPUT 710 ;"FE0"
440 BEEP
450 GOTO 170
460 END
```

LINE 130: Read 5006A signature value into A$.
LINE 140: Beep.
LINE 150: Display contents of A$.
LINE 160: Return to line 90 to take the next signature.
LINE 170: Send "FR1" command to 5006A, which enables the RECALL function.
LINE 180: Reads the Composite Signature value (accessed by RECALL) into A$.
LINE 190: Clears the HP85 display.
LINE 200: Displays the softkey labels.
LINE 210: Displays "COMPOSITE SIGNATURE" followed by the value of A$.
LINE 220: If the value of C equals 1, go to 290.
LINE 230: Assign K1 softkey label; "SCAN". If K1 is pressed, program goes to 280.
LINE 240: Assign K2 softkey label; "EDIT". If K2 is pressed, program goes to 380.
LINE 250: Displays the softkey labels.
LINE 260: Assign K1 softkey label; "SCAN". If K1 is pressed, program goes to 280.
LINE 270: Go to line 260.
LINE 280: If the value of C equals 1, go to 170.
LINE 290: Send trigger command to address 10.
LINE 300: Read 5006A signature value into A$.
LINE 310: Send "SR35" command to 5006A. The SR35 command requests the value at address "35" of an internal register.
LINE 320: Reads the value of register address location 35 into variable A.
LINE 330: Send "SR28" command to 5006A. The SR28 command requests the value at address "28" of an internal register.
LINE 340: Reads the value of register address location 28 into variable B.
LINE 350: Computes the value of the signature memory reference number for the displayed signature.
LINE 360: Displays the computed signature memory reference number followed by the corresponding signature value.
LINE 370: Go to line 260.
LINE 380: Send "FE1" command to 5006A. The FE1 command enables the EDIT function.
LINE 390: Displays the operator prompt message "TAKE A NEW SIGNATURE".
LINE 400: Send "SS1" command to 5006A, which sends the next triggered signature.
LINE 410: Read the status of 5006A by a serial poll at address 10.
LINE 420: If value of status byte is "0" (no SRQ), then loop back to line 410.
LINE 430: Send "FE0" command to 5006A. The FE0 command disables the EDIT function.
LINE 440: Beep.
LINE 450: Go to line 170.
LINE 460: End program execution.

EXAMPLE 6. READING LOGIC STATUS OF THE DATA PROBE

The following example sets the 5006A up to return the logic status of the Data Probe, each time the Data Probe switch is pressed. The status returned is then displayed on the HP85 screen, in an unabbreviated form (i.e. FL will be displayed as "FLOATING").

```
 10 OUTPUT 719 ;"SL2"
 20 ENTER 719 ; A$
 30 IF A$="PU" THEN GOTO 80
 40 IF A$="HI" THEN GOTO 100
 50 IF A$="LO" THEN GOTO 120
 60 DISP "THE NODE PROBED WAS FL
    OATING"
 70 GOTO 10
 80 DISP "THE NODE PROBED WAS PU
    LSING"
 90 GOTO 10
100 DISP "THE NODE PROBED WAS HI
    GH"
110 GOTO 10
120 DISP "THE NODE PROBED WAS LO
    W"
130 GOTO 10
140 END
```

LINE 10: Send command "SL2" to 5006A. The SL2 command requests the logic status of the Data Probe on the next triggered signature.
LINE 20: Read 5006A response into A$.
LINE 30: If value of A$ is "PU", go to Line 80.
LINE 40: If value of A$ is "HI", go to line 100.
LINE 50: If value of A$ is "LO", go to line 120.
LINE 60: Display operator prompt message for FLOATING probe response.
LINE 70: Go to line 10.
LINE 80: Display operator prompt message for PULSING probe response.
LINE 100: Display operator prompt message for HIGH probe response.
LINE 110: Go to line 10.
LINE 120: Display operator prompt message for LOW probe response.
LINE 130: Go to line 10.
LINE 140: End program execution.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the 5006A using the specifications in *Table 1-1* as a standard. Two levels of tests are provided; Operation Verification Tests and Performance Tests. The Operation Verification tests, beginning with paragraph 4-9, check the major functions of the 5006A in both Local and Remote operation. These tests may be performed to provide a high degree of confidence that the 5006A is operating properly. The Operation Verification Tests should be useful for incoming QA, and after instrument repair or routine maintenance. The Performance Tests, beginning with paragraph 4-22, measure instrument's performance against the given specifications. All tests may be performed without access to the interior of the instrument.

4-3. EQUIPMENT REQUIRED

4-4. The equipment required for the operation verification procedures is listed in *Table 1-2*. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model numberrs.

4-5. CALIBRATION CYCLE

4-6. The 5006A requires periodic verification of operation. Depending on the use and environmental conditions, the 5006A should be checked using the Operation Verification procedure at least once every year.

4-7. TEST RECORD

4-8. Results of the Operation Verification tests may be tabuled on *Table 4-2,* Operation Verification Test Record, located at the end of the procedures. Results of the Performance Tests may be tabulated on *Table 4-3,* Performance Test Record.

4-9. OPERATION VERIFICATION TESTS

4-10. Local Operation. The local operation of the HP 5006A may be verified by performing the two-part SELF-TEST described in paragraph 4-12. The first part of the test automatically verifies a majority of the instrument circuitry, including all cables, then displays the results as either a "PASS" or "F-xx" (Fail) message. The second part of the test initiates a front panel LED verification cycle, which is activated by the operator by pressing the Data Probe Switch. This test allows each individual front panel LED and display segment to be visually verified. The SELF-TEST requires no additional equipment.

4-11. Remote Operation. The remote operation of the HP5006A may be verified by performing the Interface Test described in paragraph 4-14. *The Interface Test verifies either interface; Option 030 HP-IL or Option 040 HP-IB.*

4-12. SELF-TEST VERIFICATION

4-13. The following SELF-TEST can be used to verify other circuits not checked in the power-up self-check routine. The procedure is as follows:

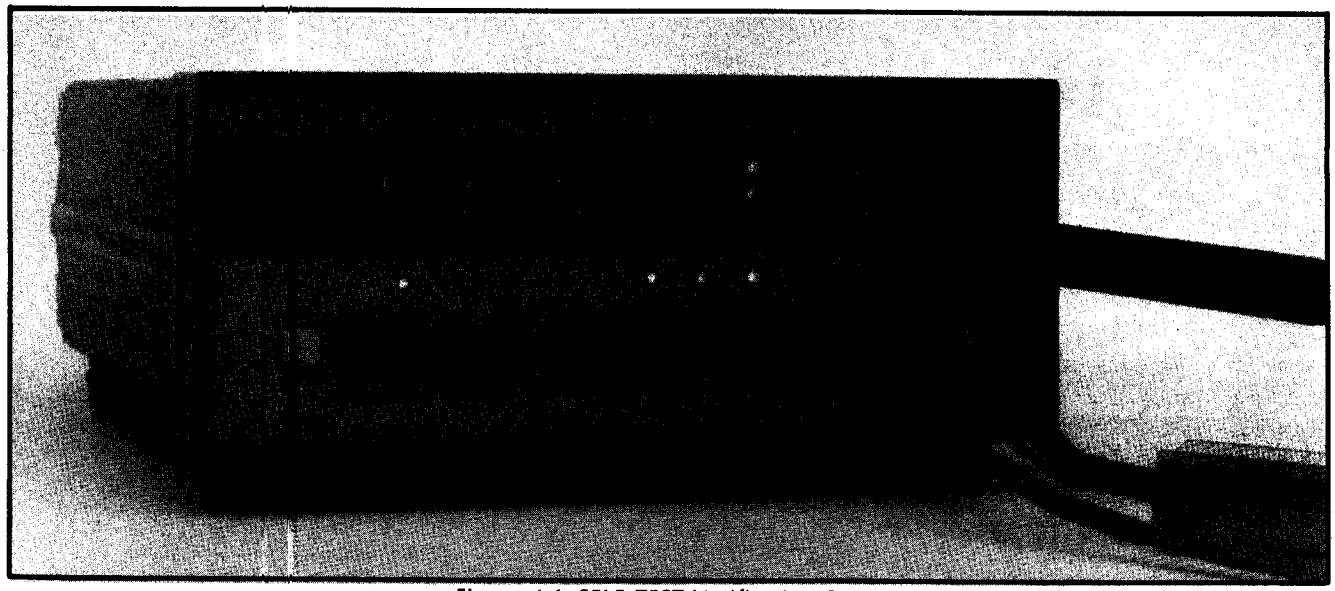


Figure 4-1. SELF-TEST Verification Setup

a. Turn the 5006A ON, by pressing in the POWER switch.

b. Insert the Data Probe tip into the PROBE test connector on the front panel.

c. Connect the START, STOP, CLOCK, and GND Timing Pod inputs to corresponding POD test connectors on the front panel. See *Figure 4-1.*

d. Verify that all front panel LEDs flash (some very briefly) and the display flashes "PASS". Record results on *Table 4-2.*

The SELF-TEST cycle is activated when the GND Timing Pod lead is connected. A flashing failure display will appear whenever the GND lead is connected and any of the other leads or the probe tip is not connected. The SELF-TEST displays should respond as follows:

		Probe Tip	
		Unconnected	**Connected**
Start, Stop Clock Leads	Unconnected	F-30	F-33
	Connected	F-30	Pass

e. Press the probe switch and observe the front panel LED test. Verify that each front panel LED and each display segment lights, in sequence. Record results on *Table 4-2.*

4-14. INTERFACE VERIFICATION

4-15. The HP 85A program listed in *Table 4-1* exercises the 5006A through the majority of its command code set via the HP-IB. If the 5006A successfully completes all checkpoints of the verification program, then there is a high probability that the HP-IB (A5) or HP-IL (A4) assembly is functioning properly.

4-16. To perform the verification, set up the equipment as shown in *Figure 4-2.* Note that in addition to the HP 85A and the HP 5006A, the following equipment is required:

00085-15003	Input/Output ROM
82936A	ROM Drawer
82937A	HP-IB Interface Card/Cable
	or
82938A	HP-IL Interface

4-17. The program listed in *Table 4-2* may be keyed into the HP 85A or loaded from an HP-IB Verification Cassette, HP P/N 59300-10002 Revision F (or later). The test enables, then verifies that each of the front panel functions, polarities, and display digits can be remotely programmed.

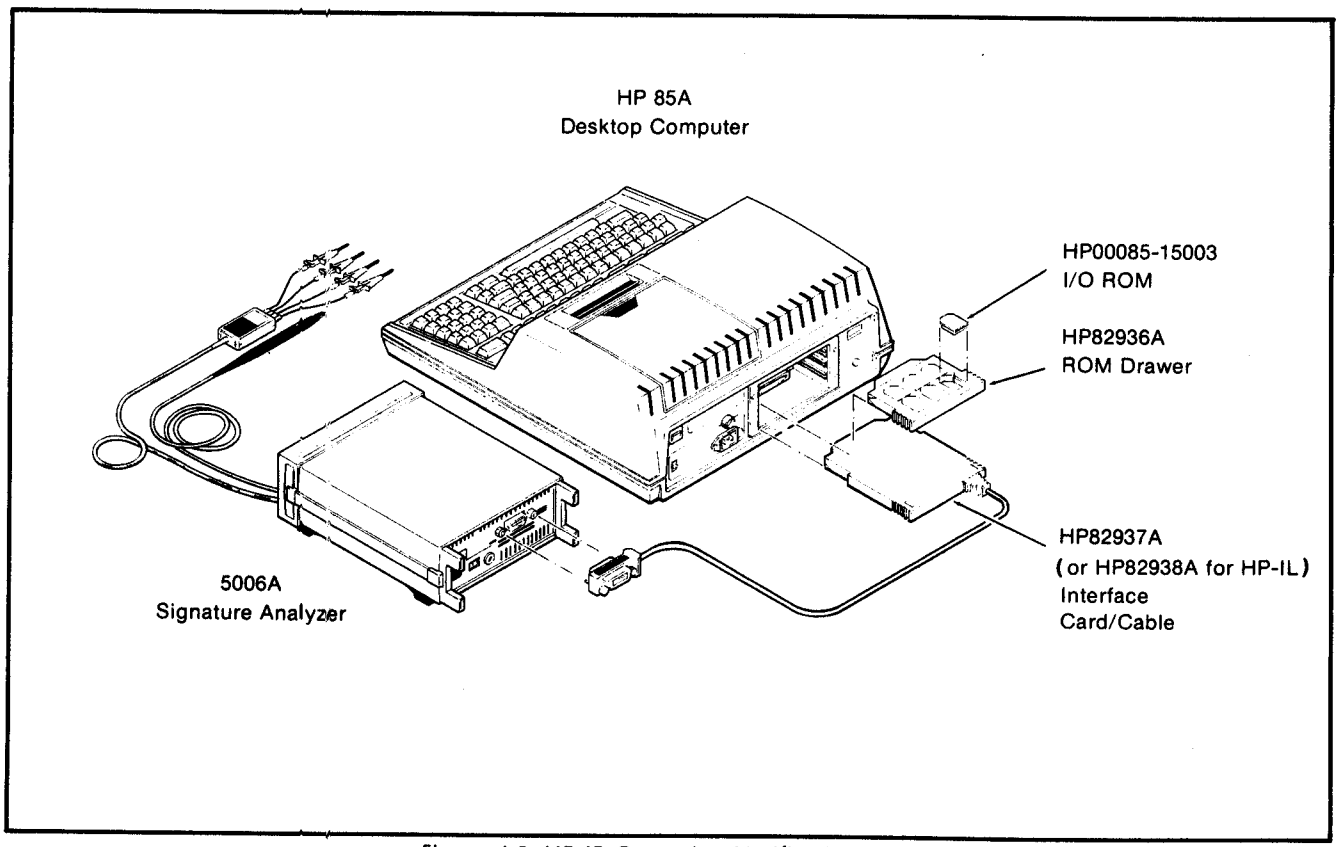
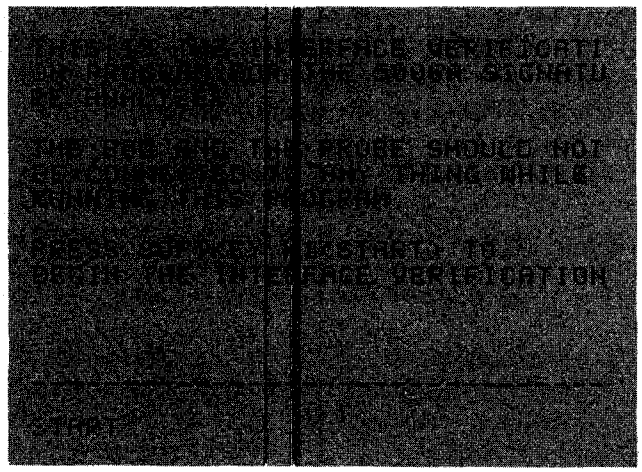


Figure 4-2. HP-IB Operation Verification Setup

4-18. To run the program, insert the cassette in the HP 85A and power up the controller. If the controller power is already on, insert the cassette and type:

CHAIN "Autost" END LINE

4-19. Press the softkey corresponding to 5006A. The program will load and run automatically. The 5006A REMOTE and LISTEN indicators should be lighted and the display should contain "HP-Ib". The program begins by identifying the program title, instrument, and operator instructions on the HP 85A screen, as shown below:



4-20. Press START (K1) to begin the test. The HP-IB Verification program takes approximately five seconds to complete, during which time the FUNCTION and POLARITY indicators (except for EDIT) will light momentarily. If the test is sucessfully completed, the 5006A will display "PASS", and the HP 85A screen will display:

"INTERFACE VERIFICATION PASSED"

4-21. If the test fails to run after START (K1), check the address of the 5006A. It may be set to any address except "21" (HP controllers are preset to address 21), or "31" (talk-only mode). Recheck the configuration of the controller (see paragraph 4-16) and the interface cable connections. Instrument failures during the test will result in an "FAIL" display on the 5006A, and a list of the test(s) failed displayed on the HP 85A screen. Fail messages are followed by the instruction "PERFORM SELF-TEST". Record results on *Table 4-2.*

Table 4-1. Interface Operation Verification Program Listing

```
10 ! THIS PROGRAM IS THE INTERFACE VERIFICATION FOR A SIGNATURE
20 ! ANALYZER, THE HP5006A.
30 ! THE PURPOSE OF THIS PROGRAM IS TO EXERCISE AN INSTRUMENT USING
40 ! MOST OF ITS INTERFACE COMMANDS.
50 ! THIS IS ACHIEVED, FIRST,BY ENABLING THE FUNCTIONS AND THEN CHECKING
60 ! IF INFACT EACH FUNCTION WAS ENABLED, AND SECOND, BY DISABLING EACH
70 ! FUNCTION AND THEN CHECKING IF EACH FUNCTION WAS DISABLED.
80 ! IT ALSO PRINTS OUT THE APPROPRIATE MESSAGES.
90 ! THE FOLLOWING BLOCK DISPLAYS THE STARTING INSTRUCTIONS.
100 ! ************************
110 !
120 DIM A$[2],D$[7],S$[10],M$[80]
130 CLEAR
140 DISP "THIS IS THE INTERFACE VERIFICA- TION PROGRAM FOR THE 5006A"
150 DISP "SIGNATURE ANALYZER."
160 DISP
170 DISP "THE POD AND THE PROBE SHOULD NOTBE CONNECTED TO ANYTHING WHILE"
180 DISP "RUNNING THIS PROGRAM."
190 DISP
200 DISP "PRESS SOFTKEY K1(START) TO      BEGIN THE INTERFACE VERIFICATION"
210 ON KEY# 1,"START" GOTO 240
220 KEY LABEL
230 GOTO 210
240 CLEAR
250 DISP "ENTER THE 10 DIGIT S/N LISTED ONTHE REAR PANEL OF THE INSTRUMENT"
260 DISP "PRESS 'ENDLINE' TO CONTINUE"
270 INPUT S$
280 !
290 ! ************************
300 !
310 ! THIS BLOCK SEARCHES FOR THE INTERFACE ADDRESS OF THE 5006A.  IF A
320 ! 5006A IS NOT FOUND, PROGRAM STOPS AFTER DISPLAYING FEW MESSAGES.
330 CLEAR @ DISP "SEARCHING FOR THE INTERFACE     ADDRESS.."
340 SET TIMEOUT 7;100
350 FOR N=700 TO 731
360 D$="NO5006A"
370 IF N=721 THEN GOTO 440
380 REMOTE N
390 OUTPUT N ;"ID"
400 ENTER N ; D$
410 IF D$="HP5006A" THEN GOTO 590
420 LOCAL N
430 ABORTIO 7
440 NEXT N
450 CLEAR
460 DISP "HP5006A NOT FOUND. CHECK, IF IT IS POWERED-UP."
470 DISP "CHECK INTERFACE CABLE           CONNECTIONS." @ DISP
480 DISP "CHANGE THE 5006A TO ADDRESSABLE MODE IF IT IS IN TALK ONLY MODE."
490 DISP
500 DISP "CHECK THE INTERFACE BOARD INSIDETHE  5006A FOR A PROBLEM." @ DISP
510 DISP "AFTER CORRECTING THE SITUATION, TRY RUNNING THE PROGRAM AGAIN."
520 END
530 !
540 ! ************************
550 !
560 ! IF 5006A IS FOUND THEN THIS BLOCK INITIALIZES THE INSTRUMENT AND
570 ! STARTS THE TEST. IT ALSO DISPLAYS "HP-Ib" ON THE DISPLAY OF 5006A.
580 !
590 PRINT "THE INTERFACE VERIFICATION TEST RESULTS OF INSTRUMENT"
600 PRINT "S/N ";S$;" ARE:"
610 PRINT
```

Table 4-1. Interface Operation Verification Program Listing (Continued)

```
620 CLEAR
630 DISP "TEST IN PROGRESS.                PLEASE DO NOT DISTURB!"
640 E=0
650 CLEAR N
660 OUTPUT N ;"FORPO"
670 OUTPUT N ;"RA55RB103RC49RD31"
680 WAIT 2000
690 !
700 ! ********************
710 !
720 ! THIS BLOCK CHECKS THE BUS DRIVERS ON THE INTERFACE BOARD OF
730 ! THE 5006A.
760 CONTROL 7,16 ; 128
770 PRINTER IS N
780 PRINT USING "K" ; "LE"&CHR$(85)
790 CONTROL 7,16 ; 2
800 PRINTER IS 2
810 OUTPUT N ;"SE"
820 ENTER 710 USING "%,%K" ; A$
830 IF A$="55" THEN GOTO 880
840 PRINT "INTERFACE DRIVER FAILURE.       REPLACE THE DRIVERS U1 & U2 "
850 PRINT "ON THE INTERFACE BOARD."
860 PRINT
870 GOTO 1990
880 CONTROL 7,16 ; 128
890 PRINTER IS N
900 PRINT USING "K" ; "LE"&CHR$(170)
910 CONTROL 7,16 ; 2
920 PRINTER IS 2
930 OUTPUT N ;"SE"
940 ENTER 710 USING "%,%K" ; A$
950 IF A$="::" THEN GOTO 970
960 GOTO 840
970 !
980 ! **********************
990 ! THIS BLOCK CHECKS IF RECALL FUNCTION IS DISABLED.
1000 !
1010 OUTPUT N ;"SR18"
1020 ENTER N ; A
1030 IF BIT(A,5)=1 THEN GOSUB 2140
1040 IF E=1 THEN GOSUB 2100
1050 !
1060 ! ************************
1070 ! IN THIS BLOCK THE RECALL FUNCTION IS ENABLED AND CHECKED. IT ALSO
1080 ! CHECKS FOR INTRUMENT TO BE IN REMOTE AND FOR COMPOSITE SIGNATURE
1090 ! ANNUNCIATOR TO BE ON.
1100 !
1110 OUTPUT N ;"FR1"
1120 OUTPUT N ;"SR18"
1130 ENTER N ; A
1140 IF BIT(A,3)=0 THEN GOSUB 2740
1150 IF BIT(A,5)=0 THEN GOSUB 2780
1160 IF BIT(A,7)=0 THEN GOSUB 2820
1170 IF E=1 THEN GOSUB 2100
1180 OUTPUT N ;"FRO"
1190 OUTPUT N ;"RA55RB103RC49RD31"
1200 !
1210 ! ************************
1220 ! THIS BLOCK CHECKS IF THE FOLLOWING FUNCTIONS: SIGNATURE LATCH,
```

Table 4-1. Interface Operation Verification Program Listing (Continued)

```
1230 ! UNSTABLE LATCH, AND QUALIFIER ARE DISABLED.IT ALSO CHECKS FOR THE
1240 ! QUALIFIER POLARITY TO BE LOW.
1250 !
1260 OUTPUT N ;"SR17"
1270 ENTER N ; A
1280 IF BIT(A,6)=1 THEN GOSUB 2180
1290 IF BIT(A,7)=1 THEN GOSUB 2220
1300 IF BIT(A,4)=1 THEN GOSUB 2300
1310 IF BIT(A,3)=1 THEN GOSUB 2340
1320 IF E#1 THEN GOSUB 2100
1330 !
1340 ! ************************
1350 ! THIS BLOCK CHECKS IF SIGNATURE AND UNSTABLE LATCHES CAN BE ENABLED.
1360 !
1370 OUTPUT N ;"FS1FU1"
1380 OUTPUT N ;"SR17"
1390 ENTER N ; A
1400 IF BIT(A,6)=0 THEN GOSUB 2260
1410 IF BIT(A,7)=0 THEN GOSUB 2380
1420 IF E#1 THEN GOSUB 2100
1430 WAIT 2000
1440 OUTPUT N ;"FS0FU0"
1450 !
1460 ! ************************
1470 ! THIS BLOCK CHECKS, IF QUALIFIER CAN BE ENABLED AND ITS POLARITY
1480 ! CAN BE CHANGED TO HIGH.
1490 !
1500 OUTPUT N ;"FQ1PQ1"
1510 OUTPUT N ;"SR17"
1520 ENTER N ; A
1530 IF BIT(A,4)=0 THEN GOSUB 2420
1540 IF BIT(A,3)=0 THEN GOSUB 2460
1550 IF E#1 THEN GOSUB 2100
1560 WAIT 2000
1570 !
1580 ! ************************
1590 ! THIS BLOCK CHECKS, IF CLOCK, START, AND STOP POLARITIES ARE
1600 ! FALLING EDGE.
1610 !
1620 OUTPUT N ;"SR17"
1630 ENTER N ; A
1640 IF BIT(A,0)=1 THEN GOSUB 2500
1650 IF BIT(A,1)=1 THEN GOSUB 2540
1660 IF BIT(A,2)=1 THEN GOSUB 2580
1670 IF E=1 THEN GOSUB 2100
1680 !
1690 ! ************************
1700 ! THIS BLOCK CHECKS, IF CLOCK, START, AND STOP POLARITIES ARE
1710 ! RISING EDGE.
1720 !
1730 OUTPUT N ;"RP7"
1740 OUTPUT N ;"SR17"
1750 ENTER N ; A
1760 IF BIT(A,0)=0 THEN GOSUB 2620
1770 IF BIT(A,1)=0 THEN GOSUB 2660
1780 IF BIT(A,2)=0 THEN GOSUB 2700
1790 IF E=1 THEN GOSUB 2100
1800 WAIT 2000
1810 OUTPUT N ;"RP0"
1820 IF E=1 THEN GOTO 1990
1830 !
```

Table 4-1. Interface Operation Verification Program Listing (Continued)

```
1840 ! ************************
1850 ! THIS BLOCK DISPLAYS "PASS" ON THE FRONT PANEL OF 5006A AND
1860 ! PRINTS A PASS MESSAGE.
1870 !
1880 OUTPUT N ;"RA103RB119RC91RD91"
1890 CLEAR
1900 M$="NO FAILURE OCCURED.              INTERFACE VERIFICATION PASSED"
1910 PRINT M$ @ DISP M$
1920 PRINT @ PRINT @ PRINT @ PRINT @ PRINT
1930 END
1940 !
1950 ! ************************
1960 ! THIS BLOCK DISPLAYS "FAIL" ON THE FRONT PANEL OF 5006A AND
1970 ! PRINTS A FAILURE MESSAGE.
1980 !
1990 CLEAR
2000 OUTPUT N ;"RA71RB119RC6RD14"
2010 M$="INTERFACE VERIFICATION FAILED,  PERFORM SELF-TEST"
2020 PRINT M$ @ DISP M$
2030 PRINT @ PRINT @ PRINT @ PRINT @ PRINT
2040 END
2050 !
2060 ! ************************
2070 !
2080 ! THE FOLLOWING SUBROUTINESARE CALLED, IF AN ERROR IS ENCOUNTERED.
2090 !
2100 WAIT 2000
2110 CLEAR
2120 DISP "TEST IN PROGRESS.                PLEASE DO NOT  DISTURB!"
2130 RETURN
2140 M$="FUNCTION RECALL IS NOT BEING    DISABLED"
2150 DISP M$ @ PRINT M$ @ PRINT
2160 E=1
2170 RETURN
2180 M$="SIGNATURE LATCH IS NOT BEING    DISABLED"
2190 DISP M$ @ PRINT M$ @ PRINT
2200 E=1
2210 RETURN
2220 M$="UNSTABLE LATCH IS NOT BEING     DISABLED"
2230 DISP M$ @ PRINT M$ @ PRINT
2240 E=1
2250 RETURN
2260 M$="SIGNATURE LATCH IS NOT BEING    ENABLED"
2270 DISP M$ @ PRINT M$ @ PRINT
2280 E=1
2290 RETURN
2300 M$="QUALIFIER ENABLE IS NOT BEING   DISABLED"
2310 DISP M$ @ PRINT M$ @ PRINT
2320 E=1
2330 RETURN
2340 M$="QUALIFIER POLARITY DIDN'T CHANGETO LOW"
2350 DISP M$ @ PRINT M$ @ PRINT
2360 E=1
2370 RETURN
2380 M$="UNSTABLE LATCH IS NOT BEING     ENABLED"
2390 DISP M$ @ PRINT M$ @ PRINT
2400 E=1
2410 RETURN
2420 M$="QUALIFIER ENABLE IS NOT BEING   ENABLED"
2430 DISP M$ @ PRINT M$ @ PRINT
2440 E=1
```

Table 4-1. Interface Operation Verification Program Listing (Continued)

```
2450 RETURN
2460 M$="QUALIFIER POLARITY DIDN'T CHANGETO HIGH"
2470 DISP M$ @ PRINT M$ @ PRINT
2480 E=1
2490 RETURN
2500 M$="CLOCK POLARITY DIDN'T CHANGE TO FALLING EDGE"
2510 DISP M$ @ PRINT M$ @ PRINT
2520 E=1
2530 RETURN
2540 M$="START POLARITY DIDN'T CHANGE TO FALLING EDGE"
2550 DISP M$ @ PRINT M$ @ PRINT
2560 E=1
2570 RETURN
2580 M$="STOP POLARITY DIDN'T CHANGE TO  FALLING EDGE"
2590 DISP M$ @ PRINT M$ @ PRINT
2600 E=1
2610 RETURN
2620 M$="CLOCK POLARITY DIDN'T CHANGE TO RISING EDGE"
2630 DISP M$ @ PRINT M$ @ PRINT
2640 E=1
2650 RETURN
2660 M$="START POLARITY DIDN'T CHANGE TO RISING EDGE"
2670 DISP M$ @ PRINT M$ @ PRINT
2680 E=1
2690 RETURN
2700 M$="STOP POLARITY DIDN'T CHANGE TO  RISING EDGE"
2710 DISP M$ @ PRINT M$ @ PRINT
2720 E=1
2730 RETURN
2740 M$="INSTRUMENT SHOULD BE  IN REMOTE"
2750 DISP M$ @ PRINT M$ @ PRINT
2760 E=1
2770 RETURN
2780 M$="FUNCTION RECALL IS NOT BEING    ENABLED"
2790 DISP M$ @ PRINT M$ @ PRINT
2800 E=1
2810 RETURN
2820 M$="THE COMPOSITE SIGNATURE         ANUNCIATOR IS NOT LIT"
2830 DISP M$ @ PRINT M$ @ PRINT
2840 E=1
2850 RETURN
2860 END
```

4-22. PERFORMANCE TESTS

4-23. Data Probe Setup and Hold Test. The following procedure is designed to test the setup (t_{DC}) and hold (t_{DH}) time constants within the 5006A Data Probe. Multiple pulse generators are configured to provide waveforms with adjustable duty cycles. The accuracy of the waveforms are monitored with an oscilloscope and time interval counter. The 5006A is set to the Normal Signature mode. The pulse waveform is varied for all combinations of data and clock controls. The t_{DC} or t_{DH}, displayed by the time interval counter, should remain within the given limits and the 5006A signature display should change as indicated.

Specification:

Setup Time: 10 ns (data to be valid at least 10 ns before selected clock edge)

Hold Time: 0 ns (data to be held until the occurrence of selected clock edge)

Note

The specification for Setup Time (t_{DC}) actually defines two conditions. The specification "t_{DC} = 10 ns min" means first; that the minimum or fastest allowable time between the data edge and the clock edge generated by the measurement timing source cannot be less (or faster) than 10 ns. This is a conditional requirement for the unit from which signatures will be taken. Second, given the first condition, the 5006A must now respond to the data and clock edges in less than 10 ns (max).

Likewise, the specfication for Hold Time (t_{DH}), "t_{DH} = 0 ns max", means that the maximum time the 5006A needs to hold data before the occurrence of the selected clock edge is "0 ns". During these tests, the frequency counter displays the t_{DC} and t_{DH} values for each test setup. The counter should display t_{DC} values less than 10 ns (typically 4 to 9 ns), and t_{DH} values less than 0 ns (typically -6 to 0 ns).

Equipment:

Pulse Generator	8082A
Pulse Generator	8007B
Time Interval Counter	5370B
Oscilloscope	1725A
Divide by 2 IC	74S74
Logic Lab Breadboard	5035T

Procedure:

a. Configure the equipment as shown in *Figure 4-3.*

b. Set the master pulse generator (8082) to output a squarewave, ~5 V p-p, at ~25 MHz rate. Adjust the leading and trailing edge controls for the fastest possible transition times, i.e. the squarest squarewave. Connect the pulse generator TRIGGER OUTPUT to the oscilloscope EXT TRIGGER input.

c. Set the "A" and "B" pulse generators to output squarewaves, ~5 V p-p, at a rate externally set by the master pulse generator. If 8007B pulse generators are used, set the controls as follows:

RATE	10 ns
PULSE DELAY	5 n - 50 n (DELAY)
PULSE DELAY VERNIER	Fully CCW
PULSE WIDTH	5 ns
PULSE WIDTH VERNIER	Adjust for 50-50 duty cycle
TRIGGER MODE	EXT
TRANSITION TIME	2.0 n - 0.1 μ(Sec) max
LEADING EDGE	Fully CCW
TRAILING EDGE	Fully CCW
AMPLITUDE	5V p-p
AMPLITUDE VERNIER	Adjust for 5V/p-p
OFFSET	OFF

d. Set the oscilloscope (1725) controls as follows:

CHANNEL A	DC Coupled, 2 Volts/Div
CHANNEL B	DC Coupled, 2 Volts/Div
SWEEP	AUTO
MAIN TRIGGERING	EXT
VERTICAL DISPLAY	ALT
HORIZONTAL DISPLAY	MAIN
INT TRIGGER	A
TIME/DIV	.01 -Sec

e. Set the time interval counter (5370B) trigger levels as indicated on the procedure figures. Set the 5370B controls as follows:

FUNCTION	TI
SAMPLE SIZE	1
ARMING	±TI
AC/DC	DC
START COM/SEP	SEP
SLOPES	Per procedure
TRIG LEVELS	Per procedure
÷1/÷10	÷1
50/1M	50 ohm

f. The 5006A should be set to the Normal Signature Analysis mode with Start, Stop, and Clock controls as shown in the figures. Initially with a $t_{DC} = 0$ ns, the 5006A should display "0000".

g. Using the delay and pulse width verniers of the two pulse generators (A and B), adjust the controls to produce the waveforms shown in *Figure 4-4.*

h. The t_{DC} delay can be changed by varying the pulse delay verniers of the "A" pulse generator. The 5370A will display the value of t_{DC}. Vary t_{DC} from 0 to 25 ns. The 5006A display should change from "0000" to "0001". This should occur with t_{DC} less than 10 ns. The point at which the display change occurs is the actual data "1" rising edge clocked setup time. Typical times are from 4 to 9 ns. Record the results on the Performance Test Record.

i. Repeat the procedure described in step h., for the remaining three t_{DC} tests, changing the tested slope edges as indicated in *Figures 4-5* through *4-7.* Record the results on the Performance Test Record.

j. The four data hold (t_{DH}) tests are analogous, except the 5370A displays $-t_{DH}$. That is, when the counter displays −5 ns, record the absolute value "t_{DH} = 5 ns". Perform all four t_{DH} tests, as shown in *Figures 4-8* through *4-11.* Verify that the t_{DH} specification of "0 ns max" is met. Record the results on the Performance Test Record.

Note

The following eight tests (Data Probe Setup Time, *Figures 4-4* through *4-7* and Data Probe Hold Time, *Figures 4-8* through *4-11)* all utilize the equipment setup shown in *Figure 4-3.* Each test, however, requires minor changes in control settings or procedure (e.g. change counter slope control from ⎍ to ⎏ .) As an aid to the technician, information shown in boldface type in *Figures 4-4* through *4-11,* highlight (only) the information which has changed from the previous test figure.

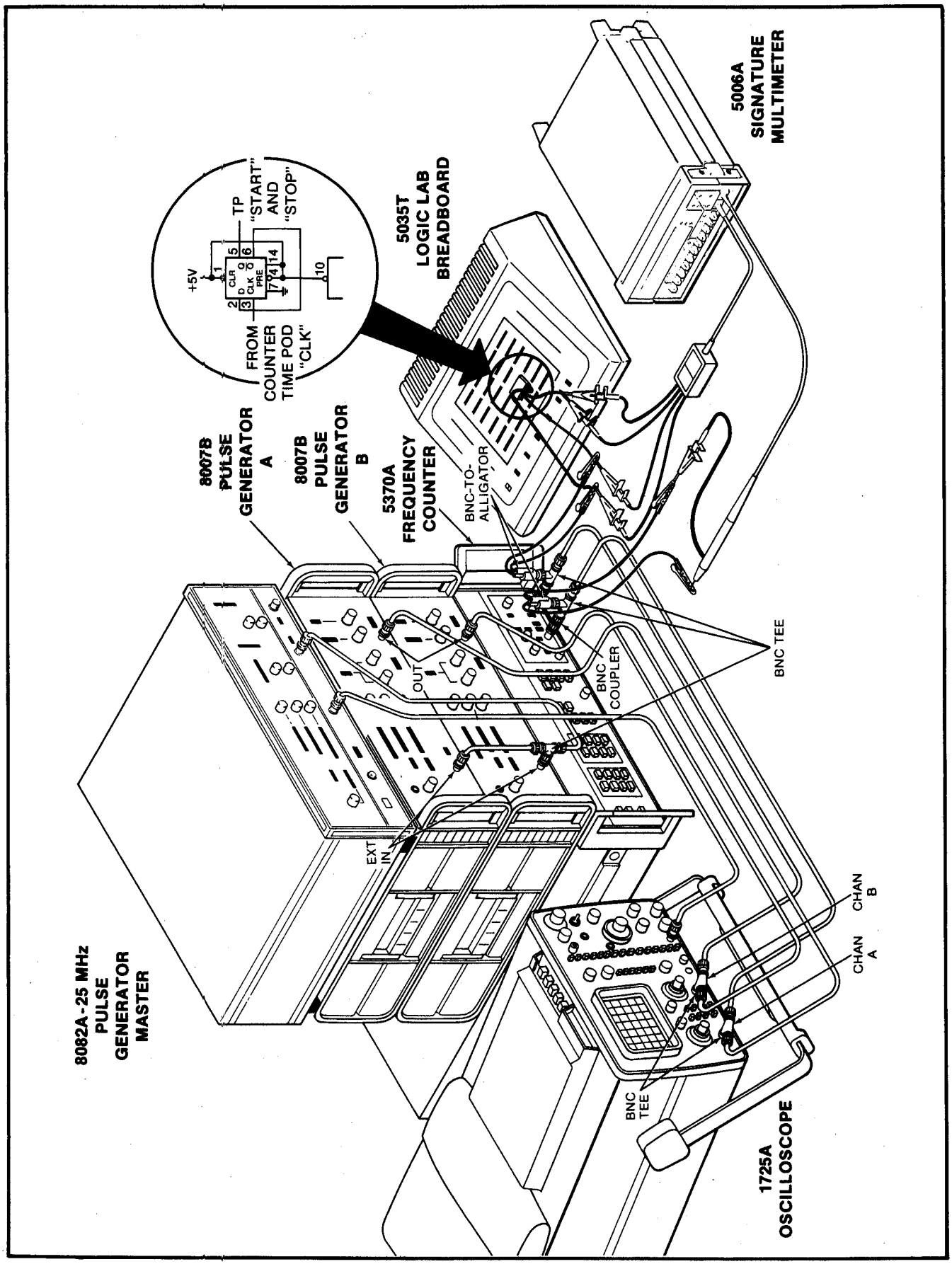
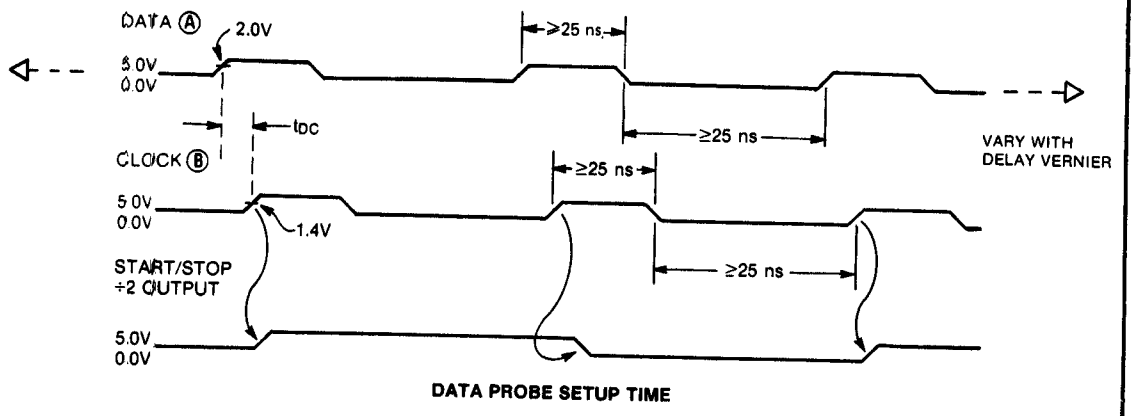


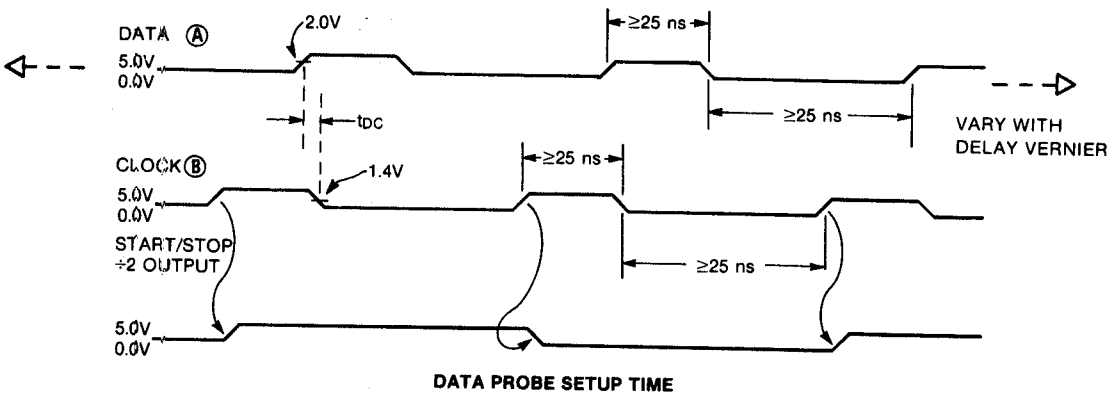
Figure 4-3. Data Probe Test Setup



DATA PROBE SETUP TIME

Setup		Method	Specifications
Waveform Edge Ⓐ Data = Lo to Hi Ⓑ Clock = Rising Edge	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DC} from 0 to 25 ns 5006A Display changes from 0000 to 0001	t_{DC} = 10 ns minimum
Set Counter Thresholds to: Data = A channel = 2.0V ƒ Clock = B channel = 1.4V ƒ			

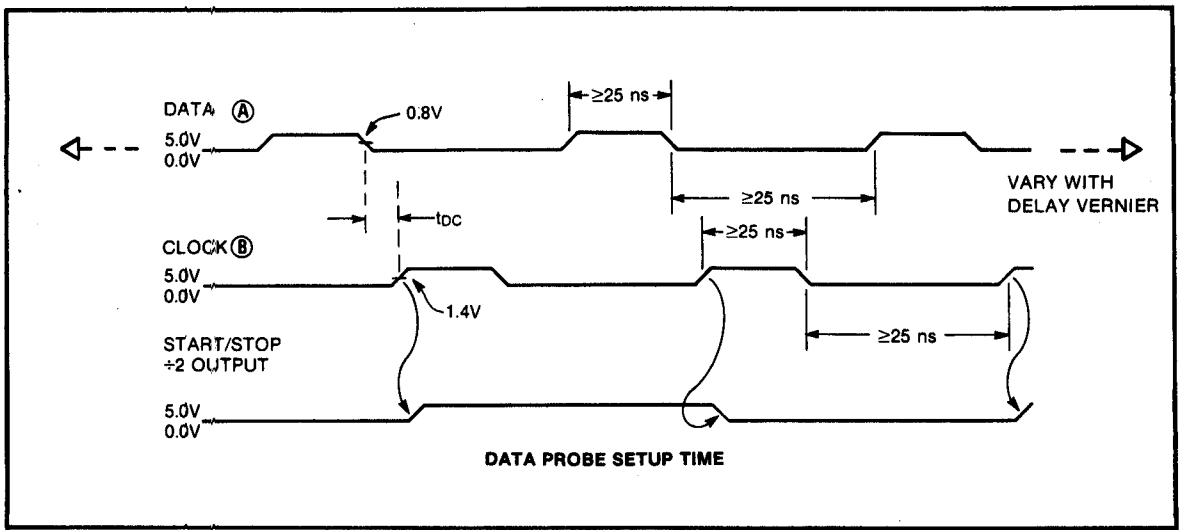
Figure 4-4. Data Probe Setup Time – Test 1



DATA PROBE SETUP TIME

Setup		Method	Specifications
Waveform Edge Ⓐ Data = Lo to Hi Ⓑ Clock = **Falling Edge**	**Set 5006A Polarity to:** START STOP **CLOCK**	Vary t_{DC} from 0 to 25 ns 5006A Display changes from 0000 to 0001	t_{DC} = 10 ns minimum
Set Counter Thresholds to: Data = A channel = 2.0V ƒ Clock = B channel = 1.4V ƒ			

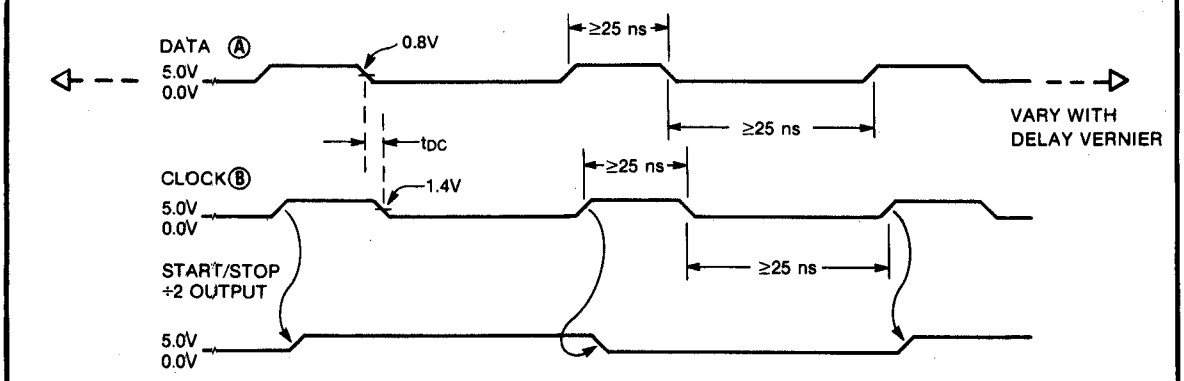
Figure 4-5. Data Probe Setup Time – Test 2



DATA PROBE SETUP TIME

Setup		Method	Specifications
Waveform Edge Ⓐ Data = **HI to Lo** Ⓑ Clock = **Rising Edge**	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DC} from 0 to 25 ns **5006A Display** changes from **0001** to **0000**	t_{DC} = 10 ns minimum
Set Counter Thresholds to: Data = A channel = **0.8V** Clock = B channel = 1.4V			

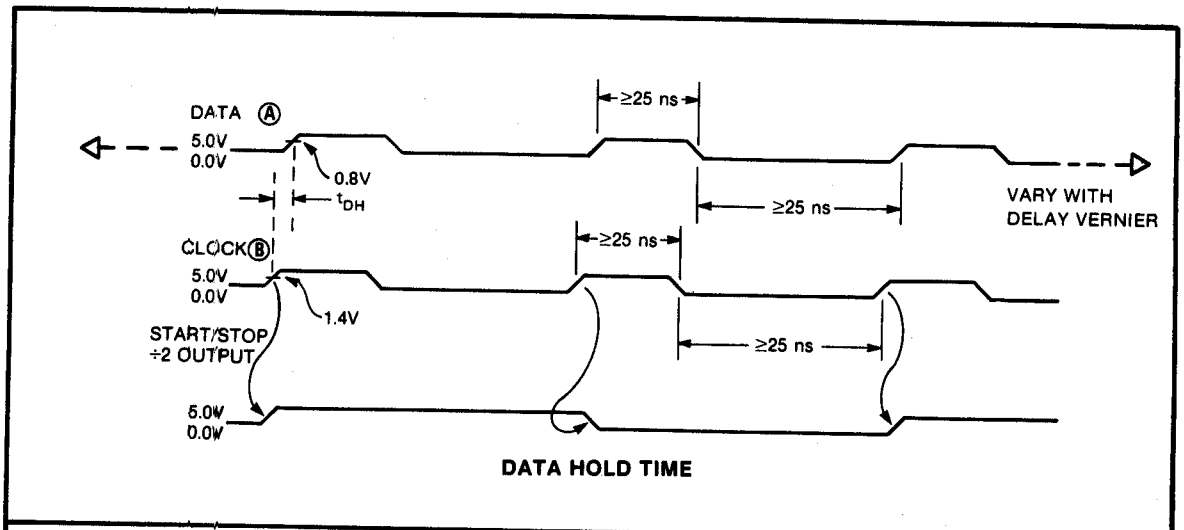
Figure 4-6. Data Probe Setup Time – Test 3



DATA PROBE SETUP TIME

Setup		Method	Specifications
Waveform Edge Ⓐ Data = Hi to Lo Ⓑ Clock = **Falling Edge**	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DC} from 0 to 25 ns **5006A Display** changes from 0001 to 0000	t_{DC} = 10 ns minimum
Set Counter Thresholds to: Data = A channel = 0.8V Clock = B channel = 1.4V			

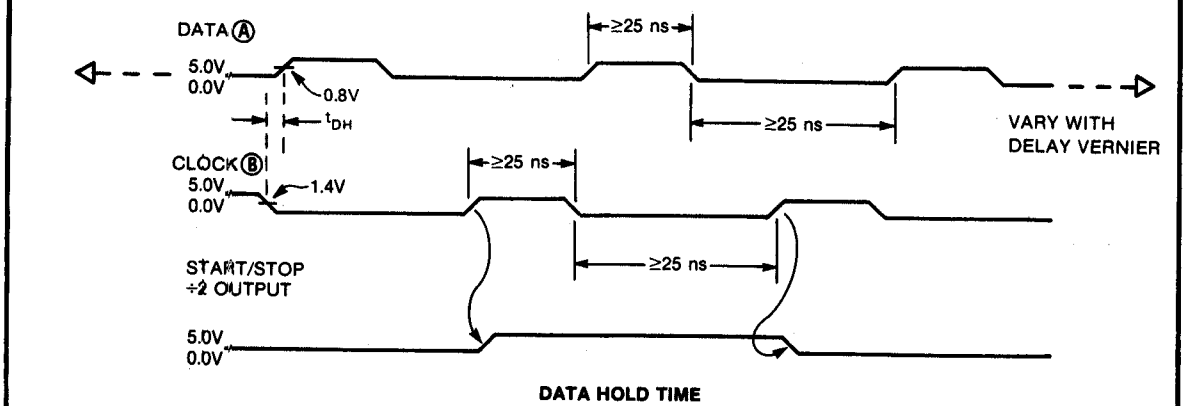
Figure 4-7. Data Probe Setup Time – Test 4



DATA HOLD TIME

Setup		Method	Specifications
Waveform Edge Ⓐ Data = **Lo to Hi** Ⓑ Clock = **Rising Edge**	**Set 5006A Polarity to:** START STOP CLOCK	**Vary t_{DH} from +10 to −10 ns** **5006A Display** changes from **0000** to **0001**	t_{DH} = 0 ns maximum
Set Counter Thresholds to: Data = A channel = 0.8V Clock = B channel = 1.4V		**Note:** Counter displays $-t_{DH}$	

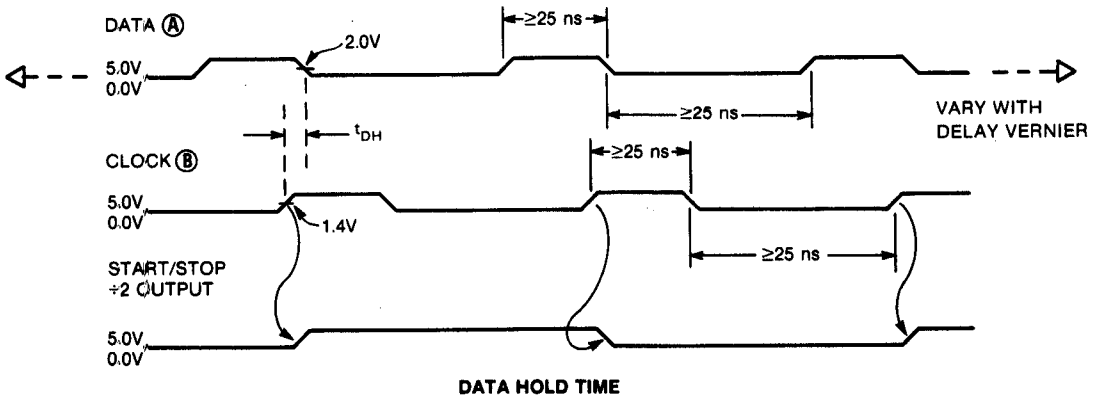
Figure 4-8. Data Hold Time - Test 1



DATA HOLD TIME

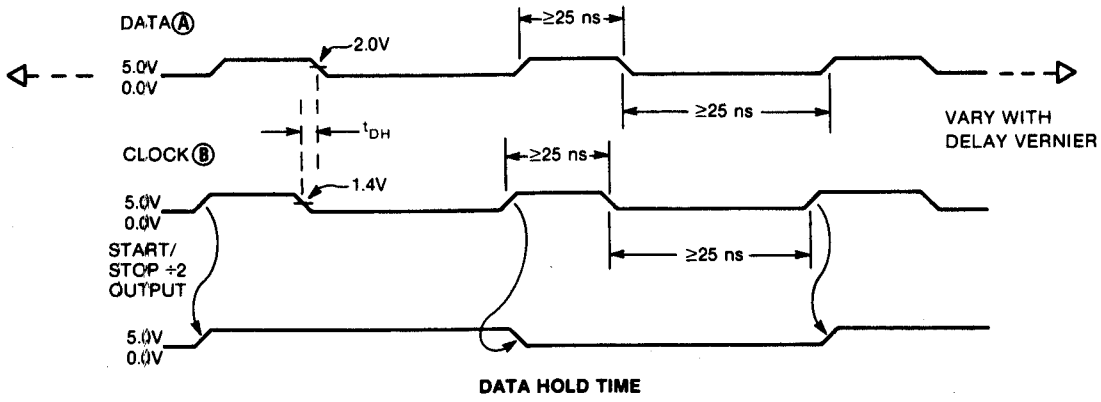
Setup		Method	Specifications
Waveform Edge Ⓐ Data = Lo to Hi Ⓑ Clock = **Falling Edge**	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DH} from +10 to −10 ns **5006A Display** changes from 0000 to 0001	t_{DH} = 0 ns maximum
Set Counter Thresholds to: Data = A channel = 0.8V Clock = B channel = 1.4V		**Note:** Counter displays $-t_{DH}$	

Figure 4-9. Data Hold Time - Test 2



Setup		Method	Specifications
Waveform Edge Ⓐ Data = **Hi to Lo** Ⓑ Clock = **Rising Edge**	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DH} from +10 to −10 ns **5006A Display** changes from **0001** to **0000**	t_{DH} = 0 ns maximum
Set Counter Thresholds to: Data = A channel = **2.0V** Clock = B channel = 1.4V		**Note**: Counter displays $-t_{DH}$	

Figure 4-10. Data Hold Time - Test 3



Setup		Method	Specifications
Waveform Edge Ⓐ Data = Hi to Lo Ⓑ Clock = **Falling Edge**	**Set 5006A Polarity to:** START STOP CLOCK	Vary t_{DH} from +10 to −10 ns **5006A Display** changes from 0001 to 0000	t_{DH} = 0 ns maximum
Set Counter Thresholds to: Data = A channel = 2.0V Clock = B channel = 1.4V		**Note**: Counter displays $-t_{DH}$	

Figure 4-11. Data Hold Time - Test 4

Table 4-2. Operation Verification Test Record

Paragraph No.	Test	Pass/Fail Results
4-13d.	SELF-TEST	_____
4-13e.	SELF-TEST LED Check	_____
4-14.	INTERFACE TEST	_____

Table 4-3. Performance Test Record

5006A S/N _____ Test Date _____

Paragraph No.		Test			
4-22.		DATA PROBE SETUP AND HOLD			
Figure	**Data**	**Clock**	t_{DC}	t_{DH}	**5006A Signature to Measurement**
4-4	Lo to Hi	pos	10 ns Min		0000 ≥ 0001 _____ ns
4-5	Lo to Hi	neg	10 ns Min		0000 ≥ 0001 _____ ns
4-6	Hi to Lo	pos	10 ns Min		0001 ≥ 0000 _____ ns
4-7	Hi to Lo	neg	10 ns Min		0001 ≥ 0000 _____ ns
4-8	Lo to Hi	pos		0 ns Max	0000 ≥ 0001 _____ ns
4-9	Lo to Hi	neg		0 ns Max	0000 ≥ 0001 _____ ns
4-10	Hi to Lo	pos		0 ns Max	0001 ≥ 0000 _____ ns
4-11	Hi to Lo	neg		0 ns Max	0001 ≥ 0000 _____ ns

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments which will return the 5006A to peak operating condition after repairs are completed. If the adjustments are to be considered valid, the 5006A line voltage must be within +5% to -10% of nominal.

5-3. In general, periodic adjustment should not be necessary. However, to assure proper calibration, it is recommended that the adjustments be performed whenever repairs are made or the instrument fails the Performance Tests listed in Section IV.

5-4. SAFETY CONSIDERATIONS

5-5. Although the 5006A has been designed in accordance with international safety standards, this manual contains cautions and warnings which MUST be followed to ensure safe operation and to retain the 5006A in safe condition (also see Section VIII of this manual). Service and adjustments should be performed only by qualified personnel.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CONDUCTOR OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE 5006A DANGEROUS.

5-6. Any adjustment, maintenance, or repair of the opened 5006A with voltage applied should be avoided as much as possible, and when inevitable should be carried out by a skilled person who is aware of the hazard involved. Capacitors inside the 5006A may still be charged even if the 5006A has been disconnected from its source of supply.

5-7. Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of repaired fuses and the short circuiting of fuseholders must be avoided. Whenever it is likely that the protection offered by fuses has been impaired, the 5006A must be rendered inoperative and secured against any operation until repaired.

WARNING

ADJUSTMENTS DESCRIBED HEREIN ARE PERFORMED WITH POWER SUPPLIED TO THE 5006A WHILE THE PROTECTIVE COVERS ARE REMOVED. ENERGY AVAILABLE AT THE REAR PANEL LINE INPUT CONNECTOR MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

5-8. EQUIPMENT REQUIRED

5-9. The test equipment required for the adjustments is listed in *Table 1-2, Recommended Test Equipment.* The critical specifications of any substituted test equipment must meet or exceed the standards listed in *Table 1-2* if the 5006A is to meet the specifications in *Table 1-1.*

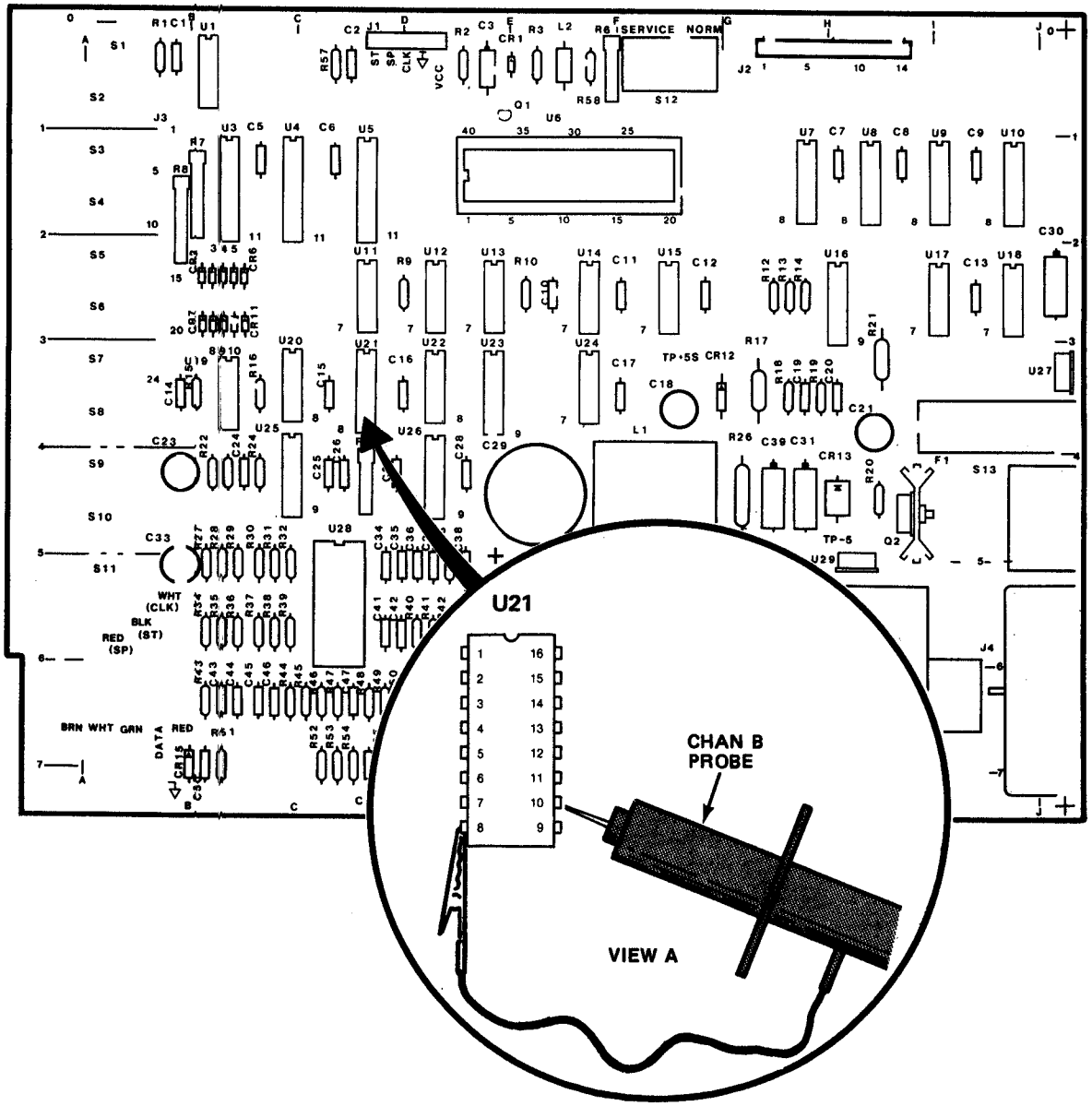
5-10. ADJUSTMENT PROCEDURE

5-11. The following procedure is provided to fine tune the high frequency compensation circuit for the Data Probe input. The procedure adjusts the input circuitry for minimum waveform distortion into the Data Probe Input Voltage Comparators. This is accomplished by applying a squarewave to the Data Probe input, while monitoring the voltage comparator output. The technician varies the dc offset of the input signal, while observing the voltage comparator output on an oscilloscope. If the input circuitry is adjusted to undercompensate, the rising edge of the waveform into the voltage comparator will be slower, and any change in the dc offset will affect the timing at the leading edge of the comparator output. If the input circuitry is adjusted to overcompensate, the waveform at the voltage comparator input will have an overshoot. At some dc offset value, the output pulse from the voltage comparator will occur only for the duration of the overshoot, with the trailing edge timing dependent on the dc offset. In a properly compensated circuit, the dc offset of the input signal can cause the appearance or disappearance of the pulse at the voltage comparator output, but will not affect its width.

5-12. The input compensation adjustment is made to produce minimum distortion in the leading and trailing edges of extremely fast input signals. It is important to use an input pulse generator with very fast transition times, typically 2 ns or better.

5-13. The following procedure adjusts the Data Probe input circuitry such that the voltage comparator output pulse appears and disappears cleanly with no change in pulse width, as the input signal DC offset is varied. To perform the adjustments, access the A1 Main Assembly and locate the connection and adjustment points as shown in *Figure 5-1*.

a. Set up the equipment as shown in *Figure 5-2*, using the shortest cables and ground leads available.



NOTE: USE IC TEST CLIP

Figure 5-1. Data Probe Input Compensation Adjustment Locator

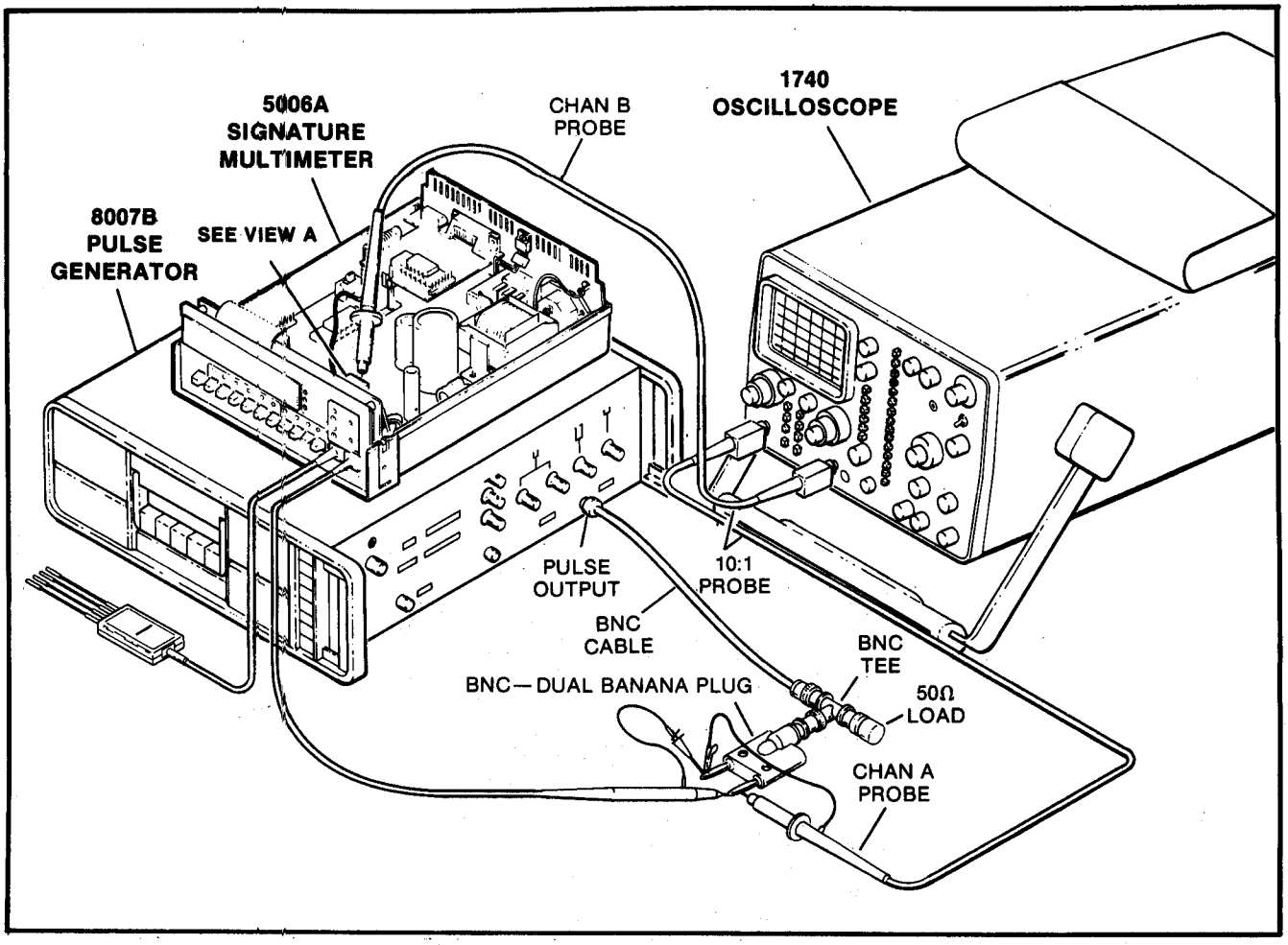


Figure 5-2. Input Compensation Adjustment Setup

b. Set the oscilloscope controls as follows:

CHANNEL A ..... DC Coupled, .02 Volts/Div
CHANNEL B ..... DC Coupled, .2 Volts/Div
SWEEP ..... AUTO
MAIN TRIGGERING ..... EXT
VERTICAL DISPLAY ..... ALT
HORIZONTAL DISPLAY ..... MAIN
INT TRIGGER ..... A
TIME/DIV ..... 0.2 mSEC

c. Set the pulse generator to output a squarewave, ~ 500 mv p-p, at a 1 KHz rate. Adjust the leading and trailing edge controls for the fastest possible transition times, i.e. the squarest squarewave. Connect the pulse generator TRIGGER OUTPUT to the oscilloscope EXT TRIGGER input. Set the pulse generator output dc offset to the adjustable mode (see *Figure 5-3*). If an HP 8007B is available, set the controls as follows:

RATE ..... .3k - 10K
RATE VERNIER ..... Adjust for 1 KHz
PULSE DELAY ..... 5 n – 50 n (DELAY)
PULSE DELAY VERNIER ..... Fully CCW
PULSE WIDTH ..... 50μ– 1.5 m(Sec)
PULSE WIDTH VERNIER ..... Adjust for 50-50 duty cycle
TRIGGER MODE ..... NORM
TRANSITION TIME .... 2.0 n – 0.1μ(Sec)
LEADING EDGE ..... Fully CCW
TRAILING EDGE ..... Fully CCW
AMPLITUDE ..... 0.5 - 1.0 (Volts)
AMPLITUDE ..... VERNIER Adjust for 500 mv/p-p
OFFSET ..... ON
OFFSET ..... VERNIER Per adjustment procedure

d. Connect the Channel A oscilloscope probe to the pulse generator PULSE OUTPUT as shown in the setup diagram.

e. Connect the Channel B oscilloscope probe to A1 U21 pin 10, and the ground wire to U21 pin 8.

f. Connect the 5006A Data Probe tip to the pulse generator PULSE OUTPUT. Connect the Data Probe ground wire to the pulse generator output ground connection.

g. Begin with the Pulse Generator OFFSET VERNIER set to the fully negative position. Due to the hysteresis of the comparator circuitry, it is important for the input voltages to approach the trigger level from the negative direction. Using the OFFSET VERNIER, slowly raise the DC offset of the input signal until the voltage comparator output (U21 pin 10), displayed on Channel B of the oscilloscope, triggers as shown in *Figure 5-4*. The Channel A POSN (position) control should be readjusted as needed to return the input waveform to the display. Using the OFFSET VERNIER, decrease the DC offset slightly, and slowly increase it again until it just begins to trigger.

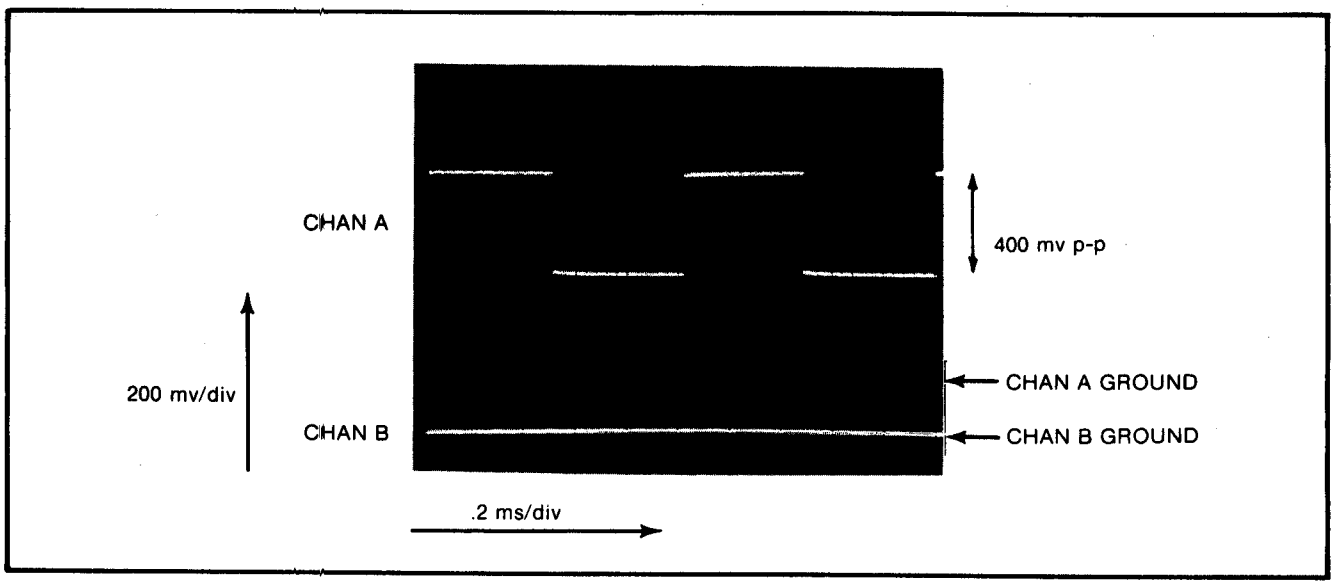


Figure 5-3. Pulse Generator Output

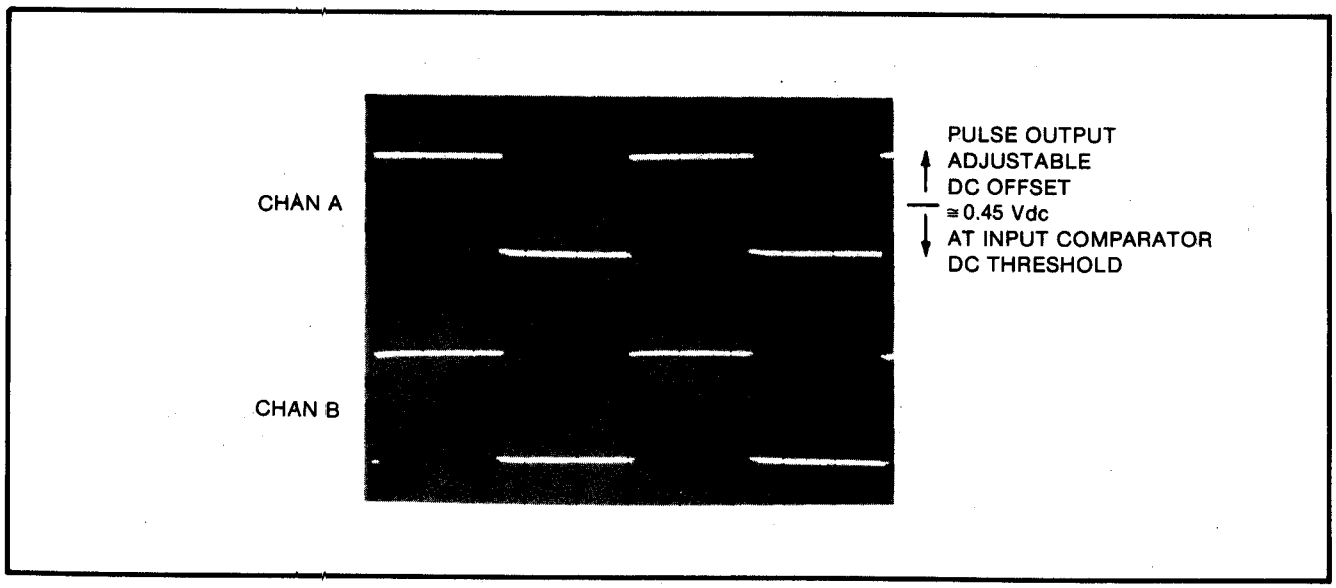


Figure 5-4. Voltage Comparator Triggering

h. If the comparator circuit is properly compensated, the comparator output squarewave will "snap in" on Channel B (*Figure 5-4*). If the comparator circuit is uncompensated, the voltage comparator output will be displayed as a narrow pulse on Channel B (see *Figure 5-5*). Adjust A1C33 in the 5006A until the narrow pulse is tuned out as shown in *Figure 5-6*. Using the OFFSET VERNIER, decrease the DC offset slightly and slowly increase it again. If the narrow pulse reappears on Channel B, readjust A1C33 to tune it out. Repeat this procedure until the comparator output squarewave "snaps in" when the DC offset is brought through the trigger level from the negative direction.

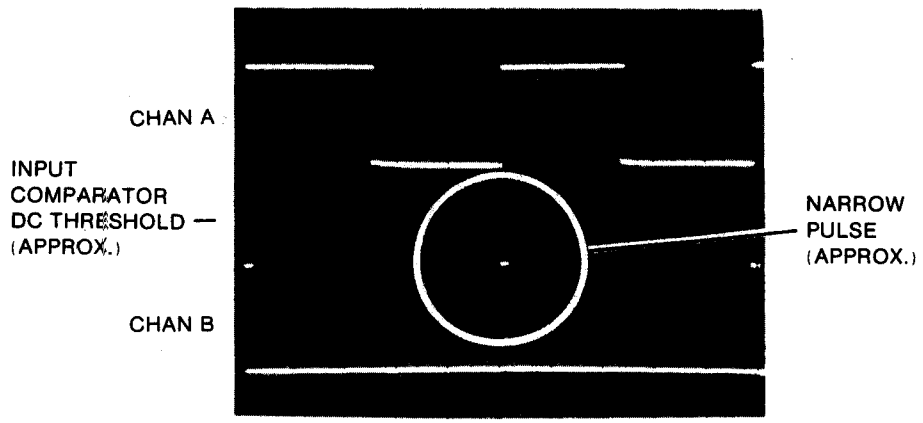


Figure 5-5. Proper Compensation (Intermittent)

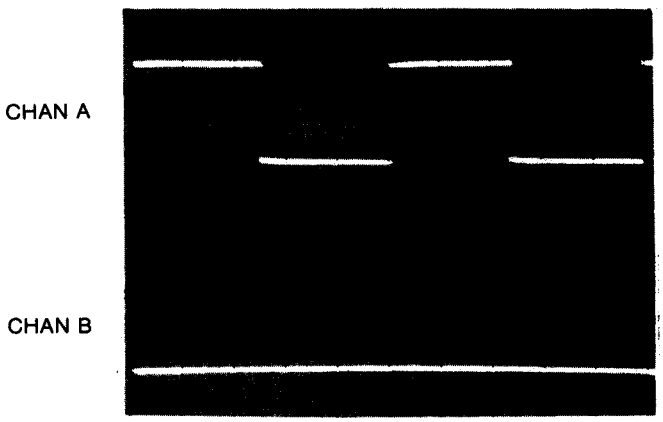


Figure 5-6. Narrow Pulse Tuned Out

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. *Table 6-1* lists abbreviations used in the parts lists and throughout the manual. *Table 6-2* lists all replaceable parts in reference designation order. *Table 6-3* contains the names and addresses that correspond with the manufacturer's code numbers.

6-3. ABBREVIATIONS

6-4. *Table 6-1* lists abbreviations used in the parts list, and throughout the manual. In some cases, two forms of the abbreviations are used, one all in capital letters and one partial or no capitals. This occurs because the abbreviations in the parts lists are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-5. REPLACEABLE PARTS LIST

6-6. *Table 6-2* is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alphanumerical order by reference designation.

b. Chassis-mounted parts in alphanumerical order by reference designation.

c. Miscellaneous parts.

6-7. The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) in the assembly.

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

6-8. The total quantity for each part is given only once — at the first appearance of the part number in the list.

6-9. MANUFACTURERS CODE LIST

6-10. *Table 6-3* contains the names and addresses that correspond to the manufacturer's code numbers.

6-11. ORDERING INFORMATION

6-12. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, the check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

6-13. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-14. DIRECT MAIL ORDER SYSTEM

6-15. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order ammount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

e. No invoices — to provide these advantages, a check or money order must accompany each order.

6-16. Mail order forms and specific ordering information is available through your HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-3. Manufacturers Code List

Mfr. No.	Manufacturer Name	Address	Zip Code
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE, WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS, TX	75222
02114	FERROXCUBE CORP	SAUGERTIES, NY	12477
03508	GE CO SEMICONDUCTOR PROD DEPT	AUBURN, NY	13201
03888	KDI PYROFILM CORP	WHIPPANY, NY	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX, AZ	85008
06383	PANDUIT CORP	TINLEY PARK, IL	60477
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW, CA	94042
13103	THERMALLOY CO	DALLAS, TX	75234
16299	CORNING GLASS WORKS CMPNT DIV	RALEIGH, NC	27604
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD, PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO, CA	94304
52763	STETTNER ELECTRONICS INC	CHATTANOOGA, TN	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS, MA	01247
91637	DALE ELECTRONICS INC	COLUMBUS, NE	68601

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A	= assembly	DL	= delay line	K	= relay	T	= transformer
AT	= attenuator; isolator; termination	DS	= annunciator; signaling device (audible or visual); lamp; LED	L	= coil; inductor	TB	= terminal board
B	= fan; motor	E	= miscellaneous electrical part	M	= metre	TC	= thermocouple
BT	= battery	F	= fuse	MP	= miscellaneous mechanical part	TP	= test point
C	= capacitor	FL	= filter	P	= electrical connector (movable portion); plug	U	= integrated circuit; microcircuit
CP	= coupler	H	= hardware	Q	= transistor; SCR; triode thyristor	V	= electron tube
CR	= diode; diode thyristor; varactor	HY	= circulator	R	= resistor	VR	= voltage regulator; breakdown diode
DC	= directional coupler	J	= electrical connector (stationary portion); jack	RT	= thermistor	W	= cable; transmission path; wire
				S	= switch	X	= socket
						Y	= crystal unit-piezo-electric
						Z	= tuned cavity; tuned circuit

ABBREVIATIONS

A	= ampere	HD	= head	NE	= neon	SPST	= single-pole, single-throw
ac	= alternating current	HDW	= hardware	NEG	= negative	SSB	= single sideband
ACCESS	= accessory	HF	= high frequency	nF	= nanofarad	SST	= stainless steel
ADJ	= adjustment	HG	= mercury	NI PL	= nickel plate	STL	= steel
A/D	= analog-to-digital	HI	= high	N/O	= normally open	SQ	= square
AF	= audio frequency	HP	= Hewlett-Packard	NOM	= nominal	SWR	= standing-wave ratio
AFC	= automatic frequency control	HPF	= high pass filter	NORM	= normal	SYNC	= synchronize
AGC	= automatic gain control	HR	= hour (used in parts list)	NPN	= negative-positive-negative	T	= timed (slow-blow fuse)
AL	= aluminum	HV	= high voltage	NPO	= negative-positive zero (zero temperature coefficient)	TA	= tantalum
ALC	= automatic level control	Hz	= hertz	NRFR	= not recommended for field replacement	TC	= temperature compensating
AM	= amplitude modulation	IC	= integrated circuit	ns	= nanosecond	TD	= time delay
AMPL	= amplifier	ID	= inside diameter	NSR	= not separately replaceable	TERM	= terminal
APC	= automatic phase control	IF	= intermediate frequency	nW	= nanowatt	TFT	= thin-film transistor
ASSY	= assembly	IMPG	= impregnated	OBD	= order by description	TGL	= toggle
AUX	= auxiliary	in	= inch	OD	= outside diameter	THD	= thread
AVG	= average	INCD	= incandescent	OH	= oval head	THRU	= through
AWG	= american wire gauge	INCL	= include(s)	OP AMPL	= operational amplifier	TI	= titanium
BAL	= balance	INP	= input	OPT	= option	TOL	= tolerance
BCD	= binary coded decimal	INS	= insulation	OSC	= oscillator	TRIM	= trimmer
BD	= board	INT	= internal	OX	= oxide	TSTR	= transistor
BE CU	= beryllium copper	kg	= kilogram	oz	= ounce	TTL	= transistor-transistor logic
BFO	= beat frequency oscillator	kHz	= kilohertz	Ω	= ohm	TV	= television
BH	= binder head	kΩ	= kilohm	P	= peak (used in parts list)	TVI	= television interference
BKDN	= breakdown	kV	= kilovolt	PAM	= pulse-amplitude modulation	TWT	= traveling wave tube
BP	= bandpass	lb	= pound	PC	= printed circuit	U	= micro (10^{-6}) used in parts list)
BPF	= bandpass filter	LC	= inductance-capacitance	PCM	= pulse-code modulation; pulse-count modulation	UF	= microfarad (used in parts list)
BRS	= brass	LED	= light-emitting diode	PDM	= pulse-duration modulation	UHF	= ultrahigh frequency
BWO	= backward-wave oscillator	LF	= low frequency	pF	= picofarad	UNREG	= unregulated
CAL	= calibrate	LG	= long	PH BRZ	= phosphor bronze	V	= volt
ccw	= counterclockwise	LH	= left hand	PHL	= phillips	VA	= voltampere
CER	= ceramic	LIM	= limit	PIN	= positive-intrinsic-negative	Vac	= volts ac
CHAN	= channel	LIN	= linear taper (used in parts list)	PIV	= peak inverse voltage	VAR	= variable
cm	= centimeter	lin	= linear	pk	= peak	VCO	= voltage-controlled oscillator
CMO	= coaxial	LK WASH	= lockwasher	PL	= phase lock	Vdc	= volts dc
COEF	= coefficient	LO	= low; local oscillator	PLO	= phase lock oscillator	VDCW	= volts, dc, working (used in parts list)
COM	= common	LOG	= logarithmic taper (used in parts list)	PM	= phase modulation	V(F)	= volts, filtered
COMP	= composition	log	= logarithm(ic)	PNP	= positive-negative-positive	VFO	= variable-frequency oscillator
COMPL	= complete	LPF	= low pass filter	P/O	= part of	VHF	= very-high frequency
CONN	= connector	LV	= low voltage	POLY	= polystyrene	Vpk	= volts peak
CP	= cadmium plate	m	= metre (distance)	PORC	= porcelain	Vp-p	= volts peak-to-peak
CRT	= cathode-ray tube	mA	= milliampere	POS	= positive; position(s) (used in parts list)	Vrms	= volts rms
CTL	= complementary transistor logic	MAX	= maximum	POSN	= position	VSWR	= voltage standing wave ratio
CW	= continuous wave	MΩ	= megohm	POT	= potentiometer	VTO	= voltage-tuned oscillator
cw	= clockwise	MEG	= meg (10^6) (used in parts list)	p-p	= peak-to-peak	VTVM	= vacuum-tube voltmeter
D/A	= digital-to-analog	MET FLM	= metal film	PP	= peak-to-peak (used in parts list)	V(X)	= volts, switched
dB	= decibel	MET OX	= metal oxide	PPM	= pulse-position modulation	W	= watt
dBm	= decibel referred to 1 mW	MF	= medium frequency; microfarad (used in parts list)	PREAMPL	= preamplifier	W/	= with
dc	= direct current	MFR	= manufacturer	PRF	= pulse-repetition frequency	WIV	= working inverse voltage
deg	= degree (temperature interval or difference)	mg	= milligram	PRR	= pulse repetition rate	WW	= wirewound
... °	= degree (plane angle)	MHz	= megahertz	ps	= picosecond	W/O	= without
°C	= degree Celsius (centrigrade)	mH	= millihenry	PT	= point	YIG	= yttrium-iron-garnet
°F	= degree Fahrenheit	mho	= conductance	PTM	= pulse-time modulation	Zo	= characteristic impedance
°K	= degree Kelvin	MIN	= minimum	PWM	= pulse-width modulation		
DEPC	= deposited carbon	min	= minute (time)	PWV	= peak working voltage		
DET	= detector	... '	= minute (plane angle)	RC	= resistance capacitance		
diam	= diameter	MINAT	= miniature	RECT	= rectifier		
DIA	= diameter (used in parts list)	mm	= millimetre	REF	= reference		
DIFF AMPL	= differential amplifier	MOD	= modulator	REG	= regulated		
div	= division	MOM	= momentary	REPL	= replaceable		
DPDT	= double-pole, double-throw	MOS	= metal-oxide semiconductor	RF	= radio frequency		
DR	= drive	ms	= millisecond	RFI	= radio frequency interference		
DSB	= double sideband	MTG	= mounting	RH	= round head; right hand		
DTL	= diode transistor logic	MTR	= meter (indicating device)	RLC	= resistance-inductance-capacitance		
DVM	= digital voltmeter	mV	= millivolt	RMO	= rack mount only		
ECL	= emitter coupled logic	mVac	= millivolt, ac	rms	= root-mean-square		
EMF	= electromotive force	mVdc	= millivolt, dc	RND	= round		
EDP	= electronic data processing	mVpk	= millivolt, peak	ROM	= read-only memory		
ELECT	= electrolytic	mVp-p	= millivolt, peak-to-peak	R&P	= rack and panel		
ENCAP	= encapsulated	mVrms	= millivolt, rms	RWV	= reverse working voltage		
EXT	= external	mW	= milliwatt	S	= scattering parameter		
F	= farad	MUX	= multiplex	s	= second (time)		
FET	= field-effect transistor	MY	= mylar	... "	= second (plane angle)		
F/F	= flip-flop	μA	= microampere	S-B	= slow-blow fuse (used in parts list)		
FH	= flat head	μF	= microfarad	SCR	= silicon controlled rectifier; screw		
FOL H	= fillister head	μH	= microhenry	SE	= selenium		
FM	= frequency modulation	μmho	= micromho	SECT	= sections		
FP	= front panel	μs	= microsecond	SEMICON	= semiconductor		
FREQ	= frequency	μV	= microvolt	SHF	= superhigh frequency		
FXD	= fixed	μVac	= microvolt, ac	SI	= silicon		
g	= gram	μVdc	= microvolt, dc	SIL	= silver		
GE	= germanium	μVpk	= microvolt, peak	SL	= slide		
GHz	= gigahertz	μVp-p	= microvolt, peak-to-peak	SNR	= signal-to-noise ratio		
GL	= glass	μVrms	= microvolt, rms	SPDT	= single-pole, double-throw		
GND	= ground(ed)	μW	= microwatt	SPG	= spring		
H	= henry	nA	= nanoampere	SR	= split ring		
h	= hour	NC	= no connection				
HET	= heterodyne	N/C	= normally closed				
HEX	= hexagonal						

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^9
M	mega	10^6
k	kilo	10^3
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	05006-60005	3	1	POD BOARD ASSEMBLY (SERIES 2240)	28480	05006-60005
A6C1	0160-2255	1	3	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A6C2	0160-2255	1		CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A6C3	0160-2255	1		CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A6R1	0698-3986	6	3	RESISTOR 89K .1% .125W F TC=0+-25	28480	0698-3986
A6R2	0698-3986	6		RESISTOR 89K .1% .125W F TC=0+-25	28480	0698-3986
A6R3	0698-7231	2	3	RESISTOR 619 1% .05W F TC=0+-100	24546	C3-1/8-TO-619R-F
A6R4	0698-7231	2		RESISTOR 619 1% .05W F TC=0+-100	24546	C3-1/8-TO-619R-F
A6R5	0698-3986	6		RESISTOR 89K .1% .125W F TC=0+-25	28480	0698-3986
A6R6	0698-7231	2		RESISTOR 619 1% .05W F TC=0+-100	24546	C3-1/8-TO-619R-F
A6W2	05005-60115	5	1	CBL AY-GROUND (BLACK)	28480	05005-60115
A6W3	05005-60114	4	1	CBL AY-CLOCK (YELLOW)	28480	05005-60114
A6W4	05005-60113	3	1	CBL AY-STOP (RED)	28480	05005-60113
A6W5	05005-60112	2	1	CBL AY-START (GREEN)	28480	05005-60112
				MISCELLANEOUS		
F1 FOR 115V	2110-0201	0	1	FUSE .25A 250V TD 1.25X.25 UL	28480	2110-0201
F1 FOR 230V	2110-0318	0	1	FUSE .125A 250V TD 1.25X.25 UL	28480	2110-0318
H1	2510-0200	7	1	SCREW-MACH B-32 5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H2	0515-1285	6	4	SCREW-MACH M3.5 X 0.6 35MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
H3	2360-0482	8	1	SC MC 632 1.25IO	28480	2360-0482
H4	0515-0886	3	1	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
H5	0515-0898	5	1	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
H6	0510-0592	8	1	RETAINER-PUSH ON TUB EXT .14-IN-DIA	28480	0510-0592
H7	0361-1137	2	1	RIVET-SPECIAL 4	28480	0361-1137
H8	2190-0585	1	1	WASHER-LK HLCL 3.5 MM 3.6-MM-ID	28480	2190-0585
H9	3050-0892	8	1	WASHER-FL MTLC 3.5 MM 3.8-MM-ID	28480	3050-0892
H10	0380-1332	9	1	STANDOFF-HEX M/F	28480	0380-1332
MP1	7101-0622	5	1	SHELL TOP	28480	7101-0622
MP2	7101-0623	6	1	SHELL BOTTOM	28480	7101-0623
MP3	05006-00001	3	1	PANEL-FRONT	28480	05006-00001
MP4	05006-00002	4	1	PANEL-REAR	28480	05006-00002
MP5	05006-00003	5	1	PANEL-REAR (OPT 030,040)	28480	05006-00003
MP6	05006-40002	8	1	WINDOW-DISPLAY (OPT 030,040)	28480	05006-40002
MP7	05006-40003	9	1	WINDOW-DISPLAY	28480	05006-40003
MP8	4177-0236	3	1	CLAMP TUBE HD, DN	28480	4177-0236
MP9	05006-00006	8	1	HOLDER-PROBE	28480	05006-00006
MP10	1600-1185	9	1	FASTENER-RACK MOUNT	28480	1600-1185
MP11	5001-0438	7	1	TRIM;SIDE	28480	5001-0438
MP12	5040-7201	8	1	FOOT(STANDARD)	28480	5040-7201
MP13	1460-1345	5	1	TILT STAND SST	28480	1460-1345
MP14	4040-1993	2	1	MONT FRONT HANDLE	28480	4040-1993
MP15	1460-1938	2	1	WIRE FORM HANDLE	28480	1460-1938
MP16	0890-1411	6	1	EXTRUSION HANDLE	28480	0890-1411
MP17	4040-1992	1	1	MONT REAR HANDLE	28480	4040-1992
MP18	5040-7222	3	1	FOOT NON-SKID	28480	5040-7222
MP19	4040-1991	0	1	BUMPER FOOT	28480	4040-1991
MP20	0380-1534	3	1	SPACER-SNAP-IN 1.0 IN LG; .28 IN DIA	28480	0380-1534
MP21	7121-2701	7	1	LABEL-INFORMATION 8-MM-WD 123.5-MM-LG	28480	7121-2701
MP22	05005-20209	4	1	PROBE BODY-TOP	28480	05005-20209
MP23	00546-40004	3	1	BUTTON-SWITCH	28480	00546-40004
MP24	00546-40003	2	1	RETAINER-SWITCH	28480	00546-40003
MP25	00546-00002	7	1	SWITCH-CONTACT	28480	00546-00002
MP27	00546-40002	1	1	WINDOW-LAMP PROBE	28480	00546-40002
MP28	5060-0418	7	1	PIN TIP ASSY	28480	5060-0418
MP29	00547-40005	5	1	COV-TIP	28480	00547-40005
MP30	05005-20208	3	1	PROBE BODY-BOT	28480	05005-20208
MP31	05005-40009	4	1	BOOT-PROBE CBL	28480	05005-40009
MP32	7121-2702	8	1	LABEL-INFORMATION 26-MM-WD 54-MM-LG	28480	7121-2702
MP33	05005-40001	6	1	COVER-POD	28480	05005-40001
MP34	05005-40011	8	1	BOOT-POD LEADS	28480	05005-40011
MP35	05005-40010	7	1	BOOT-POD	28480	05005-40010
MP36	7121-2703	9	1	LABEL-INFORMATION 26-MM-WD 54-MM-LG	28480	7121-2703
MP37	05005-40008	3	1	BOOT-POD CBL	28480	05005-40008
W1	8150-2846	3	2	WIRE 18AWG G/Y 300V PVC 19X30 105C	28480	8150-2846
A3W1	05006-60102	1	1	CBL ASSY-PROBE	28480	05006-60102
A6W1	05006-60101	0	1	CBL ASSY-POD	28480	05006-60101
	2680-0128	7	1	SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	3050-0756	3	1	WASHER-SHLDR NO. 4 .115-IN-ID .24-IN-OD	28480	3050-0756
	7120-3530	0	1	LABEL-WARNING .6-IN-WD 1.5-IN-LG VINYL	28480	7120-3530
	7121-2528	6	1	LABEL-INFORMATION 9-MM-WD 54-MM-LG POLYC	28480	7121-2528
	05005-60116	6	1	CBL AY-PROBE GND	28480	05005-60116
	0515-0887	4	1	SCREW-MACH M3.5 X 0.6 6MM-LG PAN-HD	00000	ORDER BY DESC

See introduction to this section for ordering information
*Indicates factory selected value

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION	QUANTITY
MP1	7101-0622	SHELL-TOP	1
MP2	7101-0623	SHELL-BOTTOM	1
MP3	05006-00001	PANEL-FRONT	1
MP4	05006-00002	PANEL-REAR	1
MP5	05006-00003	PANEL-REAR, OPTION 030, 040	1
MP6	05006-40002	WINDOW-DISPLAY, OPTION 030, 040	1
MP7	05006-40003	WINDOW-DISPLAY	1
MP8	4177-0236	SPACER TUBE-PLASTIC	4
MP9	05006-00006	HOLDER PROBE	1
MP10	1600-1185	FASTENER-RACK MOUNT	2
MP11	5001-0434	TRIM-SIDE	1
MP12	5040-7201	FOOT CABINET-FRONT	2
MP13	1460-1345	TILT STAND-STAINLESS STEEL	1
MP14	4040-1993	MOUNT, HANDLE-FRONT	1
MP15	1460-1938	WIRE FORM-HANDLE	1
MP16	0890-1411	EXTRUSION-HANDLE	1
MP17	4040-1992	MOUNT, HANDLE-REAR	1
MP18	5040-7222	FOOT CABINET-REAR, NON-SKID	2
MP19	4040-1991	BUMPER FOOT	1
MP20	0380-1534	SPACER "1" PLASTIC, OPTION 030, 040	1
MP21	0340-1070	INSULATOR-T0220 STICKY	1
A1	05006-60001	BOARD ASSY-MAIN	1
A2	05006-60002	BOARD ASSY-DISPLAY	1
A4	05006-60004	HP-IL ASSEMBLY	1
A5	05384-60005	HP-IB ASSEMBLY	1
H1	2510-0200	SCREW-MACH 8-32 .5-IN-LG PAN-HD-POZI	4
H2	0515-1285	SCREW-MACH M3.5 × 0.6 35MM-LG PAN-HD	4
H3	2360-0482	SCREW-MACH 6-32 1.25 POZI	4
H4	0515-0886	SCREW METRIC 3.0 6.0 LG POZI	4
H5	0515-0898	SCREW METRIC 4.0 6.0 LG POZI	2
H6	0510-0592	RETAINER-PUSH	3
H7	0361-1137	RIVET-SPECIAL	2
H8	2190-0585	WASHER-LOCK	4
H9	3050-0892	WASHER-FLAT	4
H10	0380-1332	STANDOFF HP-IB	2
H11	0515-0887	SCREW METRIC 3.5 6.0 LG POZI	2
H12	0624-0276	SCREW-TAPPING	4
H13	3050-0756	WASHER-INSULATING	1
W1	8150-2846	WIRE 18 (GREEN/YELLOW)	2

Part of Figure 6-1. Cabinet Parts and Hardware

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	05006-60003	1	1	DATA-PROBE ASSEMBLY (SERIES 2240)	28480	05006-60003
A3C1	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A3DS1	1990-0547	0	1	LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A3R1	0698-3985	5	1	RESISTOR 89.6K .1% .25W F TC=0+-25	28480	0698-3985
A3R2	0698-4009	6	1	RESISTOR 50K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5002-F
A3R2	0570-0662	9	1	STUD-PROBE TIP	28480	0570-0662
A3TP1	1251-4259	3	1	CONNECTOR-SGL CONT PIN .031-IN-BSC-SZ	28480	1251-4259
A4	05006-60004	2	1	HP-IL ASSEMBLY (SERIES 2243)	28480	05006-60004
A4C1	0160-4801	7	1	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A4C2	0160-4812	0	2	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A4C3	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A4C4	0180-0210	6	2	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4C5	0160-4557	0	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A4CR1	1902-0970	8	4	DIODE-ZNR 33V 5% DO-35 PD=.4W TC=+.097%	28480	1902-0970
A4CR2	1902-0970	8		DIODE-ZNR 33V 5% DO-35 PD=.4W TC=+.097%	28480	1902-0970
A4CR3	1902-0970	8		DIODE-ZNR 33V 5% DO-35 PD=.4W TC=+.097%	28480	1902-0970
A4CR4	1902-0970	8		DIODE-ZNR 33V 5% DO-35 PD=.4W TC=+.097%	28480	1902-0970
A4CR5	1901-0050	3	2	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4J1	05006-60104	3	1	CONNECTOR ASSY HP-IL	28480	05006-60104
A4J2	1251-8426	4	1	HEADER ASSY, 8 PIN	28480	1251-8426
A4L1	9100-1631	8	1	INDUCTOR RF-CH-MLD 56UH 5% .166DX.385LG	28480	9100-1631
A4L2	9100-1637	4	2	INDUCTOR RF-CH-MLD 120UH 5% .166DX.385LG	28480	9100-1637
A4R1	0757-0446	3	2	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A4R2	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4R3	0757-0446	3		RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A4R4	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4R5	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R6	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4S1	3101-2215	2	2	SWITCH-RKR DIP-RKR-ASSY 7-1A .05A 30VDC	28480	3101-2215
A4T1	9100-4226	3	1	TRANSFORMER	28480	9100-4226
A4U1	1LB3-0003	8	1	IC HPIL 28 PIN	28480	1LB3-0003
A4U2	05006-80002	2	1	EPROM-HPIL	28480	05006-80002
	1820-2650	1	2	NMOS 38P70 MPR	28480	1820-2650
A4W1	8120-3671	1	2	FLAT RIBBON ASSY 14-COND	28480	8120-3671
A5	05384-60005	0	1	HP-IB INTERFACE BOARD ASSY (SERIES 2244)	28480	05384-60005
A5C1	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A5C2	0160-4554	7	1	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A5C4	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A5C5	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A5CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5J1	1252-0268	8	1	CONNECTOR 24-PIN F MICRO-RIBBON	28480	1252-0268
A5L1	9100-1788	6	1	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A5L2	9100-1637	4		INDUCTOR RF-CH-MLD 120UH 5% .166DX.385LG	28480	9100-1637
A5R1	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R2	0698-0082	7	2	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A5R3	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R4	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A5R5	1810-0247	7	1	NETWORK-RES 16-DIP220.0 OHM X 8	01121	316B221
A5R6	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R7	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R8	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5S1	3101-2215	2		SWITCH-RKR DIP-RKR-ASSY 7-1A .05A 30VDC	28480	3101-2215
A5TP1-A5TP7	1251-8096	4	7	HEADER ASSY 7PIN	28480	1251-8096

See introduction to this section for ordering information
*Indicates factory selected value

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION	QUANTITY
MP22	7121-2701	LABEL-PROBE	1
MP23	05005-20209	PROBE BODY-TOP	1
MP24	00546-40004	BUTTON-SWITCH	1
MP25	00546-40003	RETAINER-SWITCH	1
MP26	00546-00002	SWITCH-CONTACT	1
MP27	0570-0662	STUD-PROBE TIP	1
MP28	00546-40002	PROBE LAMP WINDOW, RED PLASTIC	1
MP29	5060-0418	PIN TIP ASSY	1
MP30	00547-40005	PROBE TIP COVER	1
MP31	05005-20208	PROBE BODY-BOTTOM	1
A3	05006-60003	BOARD ASSY-PROBE	1
H14	0624-0276	SCREW-TAPPING	2
H15	0624-0340	SCREW-TAPPING	2
A3W1	05006-60102	CBL ASSY-PROBE	1

Part of Figure 6-2. Cabinet Parts and Hardware (Data Probe)

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U1	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A1U3	1820-2641	0	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS374N
A1U4	1820-2641	0		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS374N
A1U5	1820-2641	0		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS374N
A1U6	1820-3427	2	1	IC-MCU W RAM ROM	28480	1820-3427
A1U7	1820-2695	5	3	IC FF TTL F D-TYPE POS-EDGE-TRIG COM CLK	07263	74F175PC
A1U8	1820-1305	9	1	IC SHF-RGTR TTL S R-S PRL-IN PRL-OUT	01295	SN74S195N
A1U9	1820-2695	5		IC FF TTL F D-TYPE POS-EDGE-TRIG COM CLK	07263	74F175PC
A1U10	1820-2695	5		IC FF TTL F D-TYPE POS-EDGE-TRIG COM CLK	07263	74F175PC
A1U11	1820-2675	1	3	IC GATE TTL F AND-OR-INV	07263	74F64PC
A1U12	1820-2675	1		IC GATE TTL F AND-OR-INV	07263	74F64PC
A1U13	1820-2691	0	3	IC FF TTL F D-TYPE POS-EDGE-TRIG	07263	74F74PC
A1U14	1820-2691	0		IC FF TTL F D-TYPE POS-EDGE-TRIG	07263	74F74PC
A1U15	1820-2686	3	1	IC GATE TTL F AND QUAD 2-INP	07263	74F08PC
A1U16	1826-0565	5	1	IC-TL494	28480	1826-0565
A1U17	1820-1153	2	2	IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A1U18	1820-1158	2		IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A1U19	1820-2691	0		IC FF TTL F D-TYPE POS-EDGE-TRIG	07263	74F74PC
A1U20	1820-2698	1	2	IC GATE TTL F EXCL-OR QUAD 2-INP	07263	74F86PC
A1U21	1820-1015	0	1	IC MUXR/DATA-SEL TTL S 2-TO-1-LINE QUAD	01295	SN74S158N
A1U22	1820-2698	1		IC GATE TTL F EXCL-OR QUAD 2-INP	07263	74F86PC
A1U23	1820-2992	4	1	TTL 74S112 F/F	28480	1820-2992
A1U24	1820-2676	1		IC GATE TTL F AND-OR-INV	07263	74F64PC
A1U25	1820-1052	5	2	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A1U26	1820-1052	5		IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A1U27	1826-0215	2	1	IC V RGLTR TO-220	04713	MC7905.2CT
A1U28	1826-0630	5	1	IC COMPARATOR HS	28480	1826-0630
A1U29	1826-0122	0	1	IC 7805 V RGLTR TO-220	07263	7805UC
A1W1	8120-3670	0	1	CABLE ASSY 24 POST	28480	8120-3670
A1W2	05006-60103	2	1	CABLE ASSY-REGULATOR	28480	05006-60103
A1XF1	2110-0642	3	1	FUSEHOLDER-EXTR POST 6.3A 250V BAY CAP	28480	2110-0642
A1XU6	1200-0654	7	1	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
				A1 MISCELLANEOUS		
	0515-0898	5	2	SCREW-MACH M4 X 0.7 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0515-0886	3	1	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	0535-0004	9	1	NUT-HEX DBL-CHAM M3 X 0.5 2.4MM-THK	00000	ORDER BY DESCRIPTION
	1205-0349	7	1	HEAT SINK SGL PLSTC-PWR-CS	13103	6025B-TT

See introduction to this section for ordering information
*Indicates factory selected value

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION	QUANTITY
MP32	7121-2702	LABEL TOP-POD	1
MP33	05005-40001	COVER-POD	2
MP34	05005-40011	BOOT-POD LEADS	1
MP35	7121-2703	LABEL BOOT-POD	1
A6	05006-60005	BOARD ASSY-POD	
H16	0624-0276	SCREW-TAPPING	2
A6W1	05006-60101	CBL ASSY-POD	1
W2	05005-60115	CBL ASSY-GROUND (BLACK)	1
W3	05005-60114	CBL ASSY-CLOCK (YELLOW)	1
W4	05005-60113	CBL ASSY-STOP (RED)	1
W5	05005-60112	CBL ASSY-START (GREEN)	1

Part of Figure 6-3. Cabinet Parts and Hardware (Timing Pod)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	05006-60001	9	1	MAIN ASSEMBLY (SERIES 2314)	28480	05006-60001
A1C1	0160-4557	0	16	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C2	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C3	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1C4	0160-4554	7	16	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C5	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C6	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C7	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C8	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C10	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C11	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C12	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C13	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C14	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C15	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C16	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C17	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C18	0180-2827	5	2	CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A1C19	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C20	0160-4819	7	1	CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4819
A1C21	0180-2827	5		CAPACITOR-FXD 47UF+100-10% 40VDC AL	28480	0180-2827
A1C22	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C23	0180-2816	2	1	CAPACITOR-FXD 68UF+-20% 10VDC TA	28480	0180-2816
A1C24	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C25	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C26	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C27	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C28	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C29	0180-2892	4	1	CAPACITOR-FXD 2200UF+75-10% 16VDC AL	28480	0180-2892
A1C30	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1C31	0180-0374	3	3	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1C32	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C33	0121-0114	5	1	CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304322 7/25PF N300
A1C34	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C35	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C36	0160-4805	1	4	CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A1C37	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A1C38	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C39	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1C40	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1C41	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A1C42	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A1C43	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C44	0160-4791	4	3	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C45	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C46	0160-4791	4		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A1C47	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C48	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C49	0180-2988	9	1	CAPACITOR-FXD 820UF+75-10% 40VDC AL	56289	39DX827G040GJ6
A1C50	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C51	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1CR1	1901-0050	3	11	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR12	1902-0523	6	1	DIODE-ZNR 1N5340B 6V 5% PD=5W IR=1UA	04713	1N5340B
A1CR13	1901-0780	8	1	DIODE-SCHOTTKY 1N5821 30V 3A	04713	1N5821
A1CR14	1906-0096	7	1	DIODE-FW BRDG 200V 2A	04713	MDA202
A1CR15	1902-0175	5	1	DIODE-ZNR 100V 5% PD=1W IR=5UA	28480	1902-0175
A1F1	2110-0201	0	1	FUSE .25A 250V TD 1.25X.25 UL (115 VAC)	28480	2110-0201
A1F1	2110-0218	9	1	FUSE .1A 250V .25X.27 (230 VAC)	28480	2110-0218
A1J1	1251-8427	5	1	CONNECTOR POST TYPE .150-PIN-SPCG 5-CONT	28480	1251-8427
A1J2	1251-7684	4	1	CABLE ASSY 14 POST	28480	1251-7684
A1J3	1251-4743	0	1	CONNECTOR-AC PWR HP-9 MALE REC-FLG THRMP	28480	1251-4743

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1L1	9100-3017	8	1	300 MH AT 5 AMP DC	28480	9100-3017
A1L2	9100-1637	4	1	INDUCTOR RF-CH-MLD 120UH 5% .166DX.385LG	28480	9100-1637
A1Q1	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A1Q2	1853-0363	8	1	TRANSISTOR PNP SI PD=50W FT=20MHZ	03508	X45H281
A1R1	0757-0407	6	1	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R2	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1R3	0757-0284	7	2	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A1R6	1810-0368	3	1	NETWORK-RES 6-SIP10.0K OHM X 5	01121	206A103
A1R7	1810-0529	8	2	NETWORK-RES 8-SIP150.0 OHM X 4	28480	1810-0529
A1R8	1810-0529	8		NETWORK-RES 8-SIP150.0 OHM X 4	28480	1810-0529
A1R9	0698-4002	9	3	RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A1R10	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R12	0698-4002	9		RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A1R13	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A1R14	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R15	0698-4002	9		RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A1R16	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1R17	0811-3288	3	1	RESISTOR .025 10% 2W PW TC=0+-180	28480	0811-3288
A1R18	0698-5218	1	1	RESISTOR 30K .5% .125W F TC=0+-100	24546	C4-1/8-T0-3002-D
A1R19	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1R20	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1R21	0813-0050	5	1	RESISTOR 100 5% 3W PW TC=0+-20	91637	CW2B1-3W-T2-101-J
A1R22	0698-3445	2	2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A1R23	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1R24	0757-1093	8	1	RESISTOR 3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3001-F
A1R25	1810-0364	9	1	NETWORK-RES 6-SIP470.0 OHM X 5	01121	206A471
A1R26	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A1R27	0757-0346	2	4	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R28	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A1R29	0698-3329	1	4	RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R30	0757-0420	3	3	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R31	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R32	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R33	0698-8607	8	8	RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R34	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R35	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R36	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R37	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1R38	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R39	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R40	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R41	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R42	0698-5579	7	4	RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A1R43	0698-4009	6	2	RESISTOR 50K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5002-F
A1R44	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R45	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R46	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R47	0698-5579	7		RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A1R48	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R49	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R50	0698-5579	7		RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A1R51	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A1R52	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A1R53	0698-8607	8		RESISTOR 4.5K .1% .125W F TC=0+-25	28480	0698-8607
A1R54	0698-5579	7		RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A1R55	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A1R56	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R58	0698-4009	6		RESISTOR 50K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5002-F
A1S1-A1S11	3101-2581	5	11	SP MUL STA SE/PC	28480	3101-2581
A1S12	3101-2590	6	1	SS 6PDT .24K PC	28480	3101-2590
A1S13	3101-2656	5	1	SS LIN SEL 90PC	28480	3101-2656
A1T1	9100-2700	4	1	PCMNT PWR +7.6VDC	28480	9100-2700

See introduction to this section for ordering information
*Indicates factory selected value

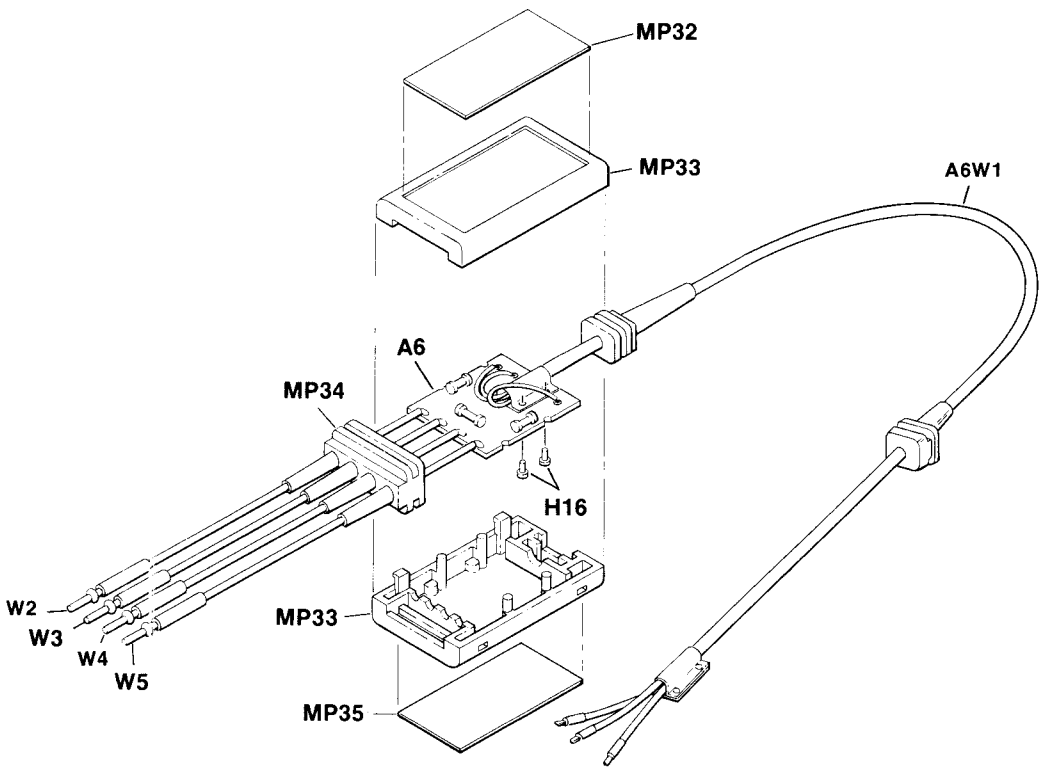


Figure 6-3. Cabinet Parts and Hardware (Timing Pod)

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	05006-60002	0	1	DISPLAY ASSEMBLY (SERIES 2314)	28480	05006-60002
A2C1	0160-4557	0	1	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	C#C04X7R104M050A
A2DS1	1990-0574	3	4	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A2DS2	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A2DS3	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A2DS4	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A2DS5	1990-0486	6	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A2DS6	1990-0547	0	15	LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS7	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS8	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS9	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS10	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS11	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS12	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS13	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS14	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS15	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS16	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS17	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS18	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS19	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2DS20	1990-0547	0		LED-LAMP LUM-INT=2MCD IF=20MA-MAX BVR=5V	28480	5082-4684,SEL IV
A2R1	1810-0206	8	1	NETWORK-RES 8-STP10.0K OHM X 7	01121	208A103
A2R2	0698-3447	4	6	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R3	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R4	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R5	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R6	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R7	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2U1	1858-0076	0	2	TRANSISTOR ARRAY 14-PIN PLSTC TO-116	04713	MC3207P
A2U2	1858-0076	0		TRANSISTOR ARRAY 14-PIN PLSTC TO-116	04713	MC3207P
A2U3	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A2W1	8120-3670	0	1	CABLE ASSY 24 POST	28480	8120-3670
				A2 MISCELLANEOUS		
	1251-4750	9	5	CONNECTOR-SGL CONT PIN .03-IN-BSC-SZ RND	28480	1251-4750
	4040-2121	0	1	STANDOFF-LED 7.5 MML	28480	4040-2121
	4040-2122	1	1	STANDOFF-LED 3MM LG	28480	4040-2122
	05006-20201	7	1	TEST POINT-PROBE	28480	05006-20201
	05006-20202	8	1	TEST POINT-CMOS	28480	05006-20202
	05006-40001	7	1	HOLDER-TEST PIN	28480	05006-40001
	05006-63100	5	1	SEQ PTS AY-68100	28480	05006-63100

See introduction to this section for ordering information
*Indicates factory selected value

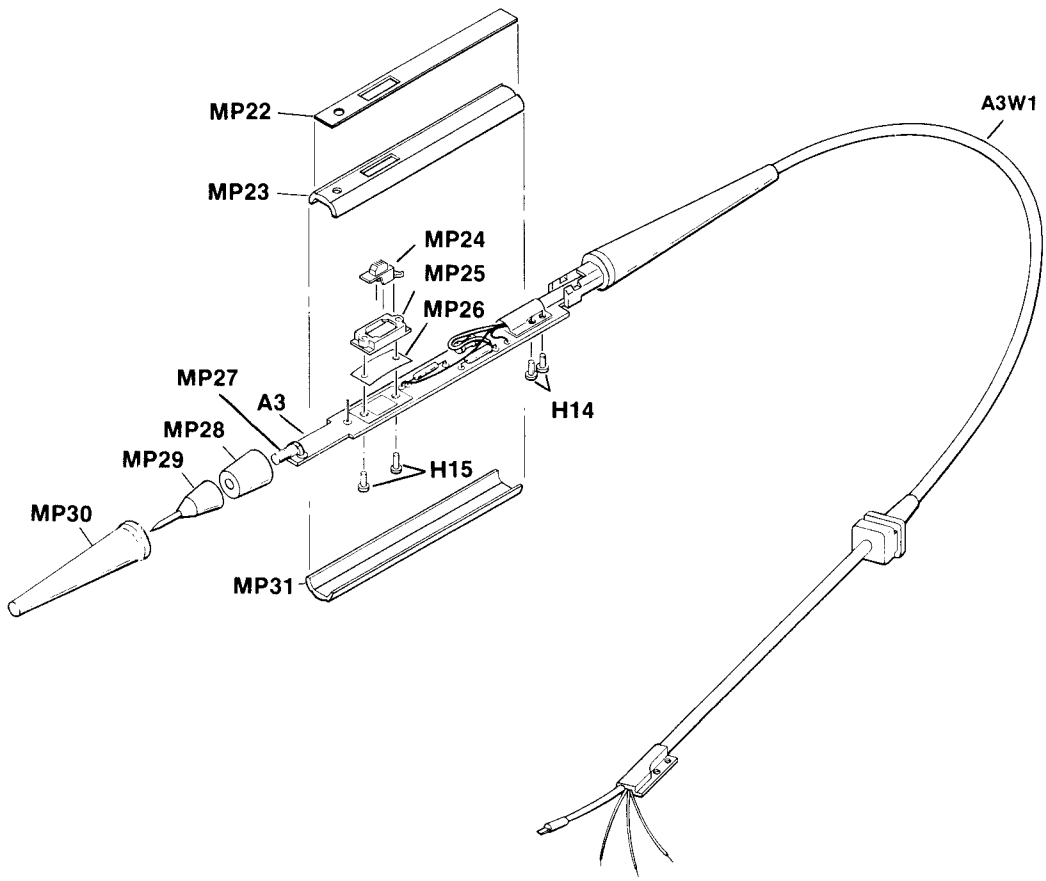


Figure 6-2. Cabinet Parts and Hardware (Data Probe)

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5U1	1820-2461	2	2	IC MISC TTL OCTL	01295	M*C3447P3
A5U2	1820-2461	2		IC MISC TTL OCTL	02195	M*C3447P3
A5U3	1820-1198	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS279N
A5U4	1820-1440	5	1	IC LCH TTL LS QUAD	01295	SN74LS03N
A5U5	1820-3970	0	1	IC MCU 4MHZ W ROM RAM	28480	1820-3970
A5W1	8120-3671	1		FLAT RIBBON ASSY 14-COND	28480	8120-3671
A5XU5	1200-0654	7	1	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654

See introduction to this section for ordering information
*Indicates factory selected value

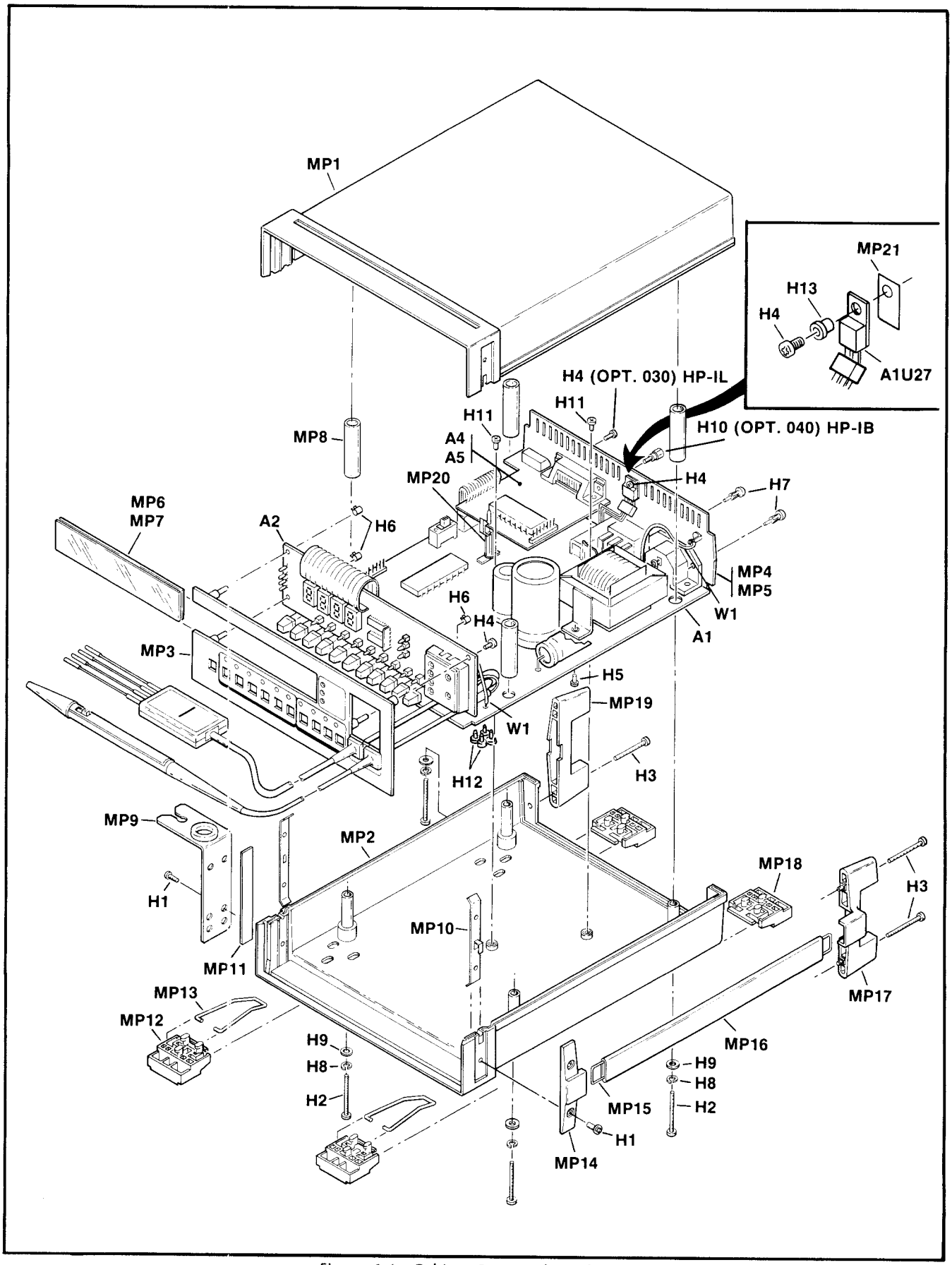


Figure 6-1. Cabinet Parts and Hardware

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	0624-0276	6	1	SCREW-TPG 2-32 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0624-0340	5	1	SCREW-TPG 8-42 .188-IN-LG BDG-HD-SLT STL	00000	ORDER BY DESCRIPTION
	10230-62101	7	5	GRABBER	28480	10230-62101
	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
	2190-0011	8	1	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
	2190-0577	1	1	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0577
	1600-0506	6	1	WASHER GRD	28480	1600-0506
	1400-0493	6	1	CABLE TIE .062-1.25-DIA .14-WD NYL	06383	P T1.5-MP8
	5041-0201	6	1	KEY CAP WHITE	28480	5141-0201
	5041-0300	6	9	KEY CAP QUARTER LIGHT GREY	28480	5141-0300
	5041-0366	6	1	KEY CAP QUARTER DARK GREY	28480	5041-0366
	0340-1070	8	1	INSULATOR TO220 STIO	28480	0340-1070
	8120-1521	6	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1521

See introduction to this section for ordering information
*Indicates factory selected value

6-17. CABINET PARTS AND HARDWARE

6-18. To locate and identify miscellaneous cabinet parts and instrument hardware, refer to *Figures 6-1* through *6-3*. These figures provide various exploded views of the instrument, identified with Reference Designators. A table is provided opposite each illustration, containing the part number, description, and quantity information for each reference designator shown. The quantity indicated represents the total number used within the instrument.

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments by making manual changes to "backdate" the manual for a particular instrument configuration as determined by the Serial Prefix Number or complete Serial Number on the rear of the instrument.

7-3. MANUAL CHANGES

7-4. This manual applies directly to model 5006A Signature Analyzers with Serial Prefix No. 2314A and includes any option 030 circuit board with SERIES number 2243 and option 040 with SERIES number 2244.

7-5. As engineering changes are made, newer instruments may have Serial Prefix numbers higher than 2314A or circuit boards for options with series numbers higher than 2243 or 2244 respectively. Manuals for these instruments will be supplied with MANUAL CHANGES, printed on yellow paper, containing the required information. Replace affected pages or change existing information as directed in the MANUAL CHANGES. If the change information is missing contact the nearest Hewlett-Packard sales and service office.

7-6. OLDER INSTRUMENTS

7-7. If your instrument has a Serial Prefix Number of 2314A or lower, refer to *Table 7-1* and perform the manual backdating change(s) that applies to your instrument. Older instruments are at the bottom of the table.

Table 7-1. Manual Backdating

If Instrument Has Serial Prefix or Option Series	Change Number	Circuit Board or Circuits Involved
2314A	1	A1, A5
2302A	2	A1, A2
2243A	2, 3	A1, A2

CHANGE 1 (2314A)

The following changes do not affect the Instrument Serial Prefix. Some units with Instrument Serial Prefix numbers 2314A have the two-chip microprocessor/ EPROM combination while later units will have a single-chip masked unit.

1. HP-IB Board Option 040 (05384-60005):
   The two-chip combination (A5U5), with part number 05384-80003, was replaced by a single-chip unit with part number 1820-3687.

   In units with serial numbers 2314A02256 or later, part number 1820-3687 is replaced with 1820-3970 (NMOS 3870 MPU).

2. A1 Main Assembly (05006-60001):
   The two-chip combination (A1U6), with part number 05006-80003, is replaced with the current unit, 1820-3424.

CHANGE 2A/B (2302A)

Part A:

Pages 6-10 and 6-12, Table 6-2. A1 (05006-60001) Replaceable Parts:
Change the A1 SERIES number from 2314 to 2302. Change the HP Part Number for A1U6 from 05006-80003 to 05006-80001.

Page 8-43, Figure 8-24. A1 MAIN ASSEMBLY SCHEMATIC DIAGRAM:
Change the A1 SERIES number from 2314 to 2302.

Part B:

Page 6-13, Table 6-2. A2 (05006-60002) Replaceable Parts:
Change the A2 SERIES number from 2314 to 2302. There is no other change to the A2 board at this time.

Page 8-45, Figure 8-25. A2 DISPLAY ASSEMBLY SCHEMATIC DIAGRAM:
Change the A2 SERIES number from 2314 to 2302.

Instruments with the following serial numbers do not have Part A of CHANGE 2.

2302A00125
2302A00128
2302A00140

2302A00157 through 2302A00165
2302A00182 through 2302A00190
2302A00216 through 2302A00221

2302A00224
2302A00225
2302A00228

CHANGE 3 (2243A)

Page 6-10, Table 6-2. A1 (05006-60001) Replaceable Parts:

Change the A1 SERIES from 2302 to 2240.
Change C22, C32 from 0160-4557 .1UF to 0160-5572 CAPACITOR-FXD 1500PF ±20% 250 VAC (RMS).

WARNING: A1 with SERIES number 2240 should always have 250V capacitors for C22 and C32.

Page 8-43, Figure 8-24. A1 MAIN ASSEMBLY SCHEMATIC DIAGRAM:

Change the A1 SERIES number from 2302 to 2240.
Delete C22 and C32 .1 UF 50V on the secondary side of the transformer.
Add C22 and C32 1500 PF 250V on the primary side of the transformer: C22 from the J4 side of the fuse to ground; C32 from T1 pin 5 to ground.

Page 6-13, Table 6-2. A2 (05002-60002) Replaceable Parts:

Change the A2 SERIES number from 2302 to 2240. There is no other change at this time to the A2 board.

Page 8-45, Figure 8-25. A2 DISPLAY ASSEMBLY SCHEMATIC DIAGRAM:

Change the A2 SERIES from 2302 to 2240.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains the information needed to service the HP Model 5006A Signature Analyzer. The information includes theory of operation, recommended test equipment, schematic diagram notes, safety considerations, assembly/disassembly procedures, troubleshooting procedures, and block and schematic diagrams.

8-3. THEORY OF OPERATION

8-4. The theory of operation is presented in two levels; first a block level description which describes the functional operation of the instrument by major blocks or stages. Second, a detailed theory presented by stages, in a format which summarizes the purpose, devices, input, output, and control signals, and describes the actual operation of the circuit.

8-5. TROUBLESHOOTING

8-6. Troubleshooting for the 5006A is presented through a series of troubleshooting flowcharts. The troubleshooting procedure utilizes a built-in diagnostic service mode, selected by a switch on the main printed circuit board. The troubleshooting procedure is organized so that only the flowcharts and procedures necessary will be indicated. Troubleshooting is accomplished using signature analysis, signal tracing, and conventional measurements. These procedures can efficiently isolate malfunctions to component level for diagnosis. Troubleshooting is keyed to the Overall Troubleshooting Flowchart shown in *Figure 8-9.*

8-7. The schematic diagrams for all of the assemblies are located at the end of this section. They are arranged in numerical order according to the assembly number (i.e., A1, A2, A3, etc.) in *Figures 8-24* through *8-28.*

8-8. RECOMMENDED TEST EQUIPMENT

8-9. Test equipment required to test the 5006A is listed in *Table 1-2.* Equipment other than that listed may be substituted if the substitute meets or exceeds the critical specifications. The following paragraphs describe equipment whose use is optional, but can prove very helpful during troubleshooting.

8-10. HP 545A Logic Probe, HP 546A Logic Pulser, and HP 547A Current Tracer.

8-11. The Logic Probe, Logic Pulser, and Current Tracer are self contained troubleshooting instruments designed to stimulate and measure digital activity in logic circuits. When bad signatures on a Signature Analyzer indicate printed circuit board opens or shorts, these instruments are very effective in isolating the specific point.

8-12. The logic Probe is a self-contained, easy-to-use tool for examining logic nodes. Continuity, signal flow, bus device, address decoder, clock, and switch activity of the 5006A may be verified. The circuits operating characteristics while in defined diagnostic loops may be examined.

8-13. The Logic Pulser forces overriding pulses into nodes. It can be programmed to output single pulses, pulse streams, or bursts. The pulser can be used to force ICs to enable or clock. When used with the Logic Probe, logic circuit inputs can be pulsed while their outputs are monitored with the probe. By this technique, correct signal propagation through logic elements can be verified.

8-14. The Current Tracer can be used to monitor current activity on a logic node or power bus, and can tell approximately how much pulse current is present and what path it takes. When a Logic Pulser is used to inject current into a nonactive (no pulse activity) node, the impedance and nature of possible stuck nodes (e.g. output, hard short) can be estimated. Then the actual low impedance point can be found by tracing the path of the current from the Logic Pulser to the location where the current either goes to a short or enters a component.

8-15. SCHEMATIC DIAGRAM NOTES AND REFERENCE DESIGNATORS

8-16. *Figure 8-1* shows common symbols used on schematic diagrams, printed circuit board identification codes, and the system for assigning reference designators, assemblies, and subassemblies. For a detailed explanation of the concepts and conventions used for schematic Logic Symbols, refer to paragraph 8-35.

SYMBOLS

DANGEROUS VOLTAGE, EXCEEDS 1000 VOLTS

FRONT PANEL LABEL

REAR PANEL LABEL

INTERIOR AND PC BOARDS LABEL

WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

PROTECTIVE CONDUCTOR TERMINAL

CIRCUIT COMMON

IDENTIFIED COMMON

CHASSIS TERMINAL

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

TEST POINT

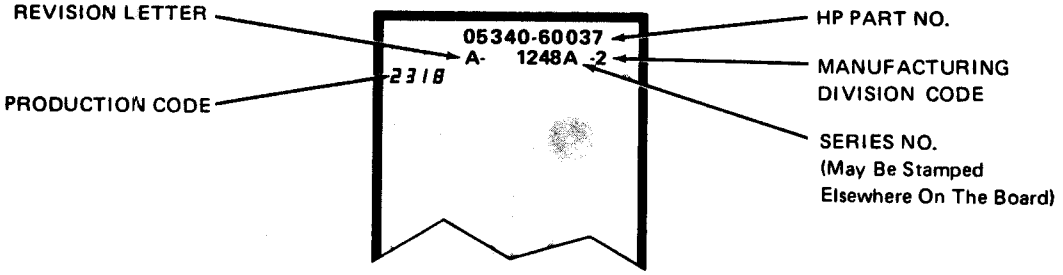
INSTRUCTION MANUAL REFERENCE

ALTERNATING CURRENT

DIRECT CURRENT

ALTERNATING OR DIRECT CURRENT

PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

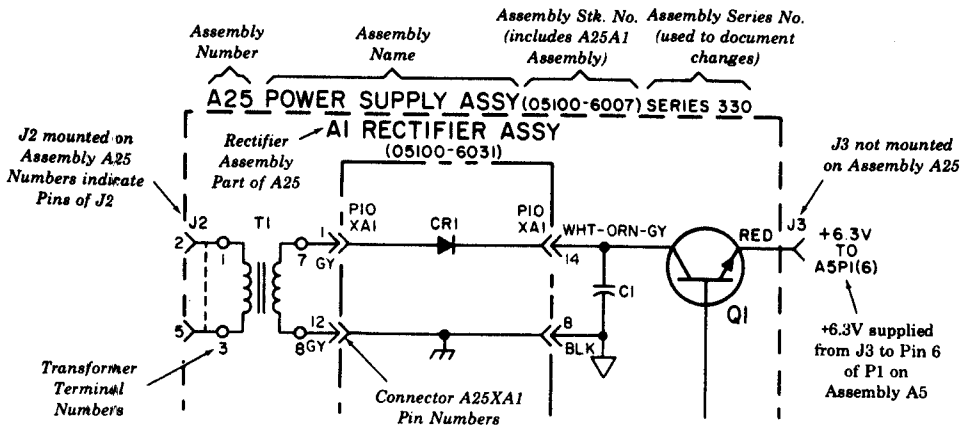


Figure 8-1. Schematic Diagram Notes

8-17. HP 5006A ASSEMBLY AND CABLE DESIGNATIONS

8-18. Assemblies within the 5006A, such as printed circuit boards, are assigned numbers in sequence, prefixed by the letter "A". There are six assemblies associated with the 5006A, identified as A1 through A6. *Table 8-1* lists the description and HP Part Number of the assemblies. Individual components on an assembly are identified by combining the component reference designator with the assembly number. For example, U28 on the A1 Main Assembly is designated A1U28.

Table 8-1. Assembly Designations

Assembly	Description	HP Part No.
A1	Main Assembly	05006-60001
A2	Display Assembly	05006-60002
A3	Data Probe Assembly	05006-60003
A4	HP-IL Interface Assembly (Opt 030)	05006-60004
A5	HP-IB Interface Assembly (Opt 040)	05384-60005
A6	Timing Pod Assembly	05006-60005

8-19. Cables and wiring harnesses are assigned numbers in sequence, prefixed by the letter "W". Cables which freely disconnect from all assemblies are identified simply as W1, W2, W3, etc. The 5006A Main Power Cable, for example, is designated "W1". Cables which are soldered to an assembly become subordinate to that assembly, such as A4W1.

8-20. Identification Marks on Printed Circuit Boards

8-21. HP printed circuit boards have three identification marks as shown in *Figure 8-1*. The marks are the HP part number for the assembly, a "SERIES" number stamped on the circuit board, and an etched revision letter. The circuit board assembly part number has ten etched digits, such as 05006-60001. The series number consists of four digits stamped in a blank space on the board. These two numbers determine the electrical configuration of the circuit board. All circuit boards with the same part number and series number are directly interchangeable.

8-22. When a production change is made in an assembly that makes the assembly not directly interchangeable with the previously manufactured assembly, the circuit board part number and/or series number(s) are changed. The series number is incremented each time an electrical change is made on the circuit board. The series changes typically consist of value changes for circuit board components such as capacitors and resistors or type number changes of active elements that do not change the boards so they are incompatible with the previous assembly.

8-23. Revision letters (A, B, C, etc.) denote changes in printed circuit layout and are incremented each time the layout is changed. The changes very often are for minor revisions in the layout to improve instrument reliability, simplify board loading, instrument production or testing but do not always change the ciruit board part number or series number. Any change which revises the circuit board layout for a change in circuitry has a change in series number and the revision letter is changed.

8-24. When replacement assemblies are ordered, you may receive a replacement with a series number that differs from the one you are replacing. If the series number on the assembly is lower, refer to Section VII, Manual Changes. Section VII contains documentation for assemblies with lower series numbers. If the number is higher, refer to the yellow looseleaf manual change sheet for this manual. If the change sheets are missing or do not cover the series number of the replacement circuit board, contact your local HP Sales and Service Office. See the listings at the back of this manual.

8-25. SAFETY CONSIDERATIONS

8-26. The 5006A has been designed in accordance with international safety standards and this manual contains information with cautions and warnings which must be followed to insure safe operation (also see Sections II through V). Service and adjustments should be performed only by qualified personnel who are aware of the hazards involved.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CONDUCTOR (INSIDE OR OUTSIDE THE 5006A) IS LIKELY TO MAKE THE 5006A DANGEROUS TO PERSONNEL.

8-27. Opening the 5006A while power is connected should be avoided as much as possible and, when necessary, should be carried out by a skilled person who is aware of the hazards involved. Capacitors inside the 5006A may still be charged even if the instrument has been disconnected from an external power supply.

8-28. Make sure that only fuses with the required rated current and of the type specified in *Table 6-2* are used for replacement. The use of repaired fuses or short circuiting of fuseholders MUST be avoided. Whenever

it is likely that protection is impaired, the 5006A must be rendered inoperative and secured against any operation until repaired.

8-29. The safety symbols in *Table 8-2* are used on HP equipment and in the associated Operating and Service Manuals.

8-30. SERVICE AIDS

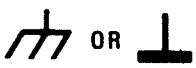
8-31. Service Aids on Printed Circuit Board

8-32. Several service aids are provided on assembly printed circuit boards. These aids include test points, reference designators, adjustment callouts, and assembly stock numbers.

8-33. Diagnostic Routines

8-34. The 5006A has two diagnostic routines. On power-up the instrument automatically goes through the Power-Up Self-Check Routine. The SELF-TEST Routine is performed by following the outlined procedure in Section IV. While the instrument is running the SELF-TEST Routine, service switch S12 on the A1 main board can be switched to the service position. The display will show F-32 which should be ignored. This will provide stable signatures for troubleshooting purposes. The service technician should have an understanding of the concepts of Signature Analysis, as an in-circuit troubleshooting technique. Hewlett-Packard makes available a variety of Application Notes on the concepts and useage of Signature Analysis. It may be helpful to contact the nearest Hewlett-Packard Sales and Service Office and request a copy of the Signature Analysis publications index; AN INDEX TO SIGNATURE ANALYSIS PUBLICATIONS, Application Note 222-0.

Table 8-2. Safety Symbols used on HP Equipment

	Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to prevent damage to the instrument.
	Indicates dangerous voltage (terminals fed from internal or external sources exceed 1000 volts.) Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating the equipment.
	Low-noise or noiseless clean ground (earth) terminal. Used for signal common as well as providing protection against electrical shock in case of fault. A terminal marked with this symbol must be connected to ground as described in Section II Installation in this manual before operating the equipment.
	Frame and chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.
	Alternating current.
	Direct current.
WARNING	The WARNING signal denotes a hazard to call attention to a procedure, practice, or the like which could result in personal injury if not adhered to or correctly performed.
CAUTION	The CAUTION signal denotes a hazard to call attention to an operating procedure, practice, or the like which could result in damage to or destruction to part of or all of the product if not adhered to or correctly performed.

8-35. LOGIC SYMBOLS

8-36. Logic symbols used in this manual conform to the American National Standard ANSI Y32.14-1973 (IEEE Std. 91-1973). This standard supersedes MIL-STD-806B. In the following paragraphs logic symbols are described. For further descriptions refer to HP Logic Symbology manual, part number 5951-6116.

8-37. Logic Concepts

8-38. The binary numbers 1 and Ø are used in pure logic where 1 represents true, yes, or active and Ø represents false, no, inactive. These terms should not be confused with the physical quantity (e.g., voltage) that may be used to implement the logic, nor should the term "active" be confused with a level that turns a device on or off. A truth table for a relationship in logic shows (implicitly or explicitly) all the combinations of true and false input conditions and the result (output). There are only two basic logic relationships, AND and OR. The following illustrations assume two inputs (A and B), but these can be generalized to apply to more than two inputs.

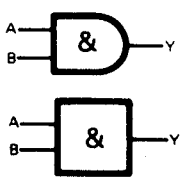
AND Y is true if and only if A is true and B is true (or more generally, if all inputs are true).
Y=1 if and only if A=1 **and** B=1
Y=A•B

OR Y is true if and only if A is true or B is true (or more generally, if one or more input(s) is (are) true).
Y=1 if and only if A=1 **or** B=1
Y=A+B

TRUTH TABLE

A	B	Y
1	1	1
1	0	0
0	1	0
0	0	0

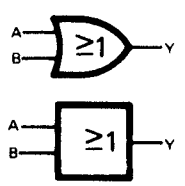
EQUIVALENT SYMBOLS



TRUTH TABLE

A	B	Y
1	1	1
1	0	1
0	1	1
0	0	0

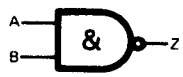
EQUIVALENT SYMBOLS



8-39. Negation

8-40. In logic symbology, the presence of the negation indication symbol o provides for the presentation of logic function inputs and outputs in terms *independent* of their physical values, the Ø-state of the input or output being the 1-state of the symbol referred to the symbol description.

EXAMPLE 1



TRUTH TABLE

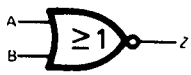
A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

EXAMPLE 2

TRUTH TABLE

A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

EXAMPLE 3



TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 4

TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 1 says that Z is *not* true if A is true *and* B is true or that Z is true if A *and* B are *not* both true. $\overline{Z}=AB$ or $Z=\overline{AB}$. This is frequently referred to as NAND (for NOT AND).

EXAMPLE 2 says that Z is true if A is *not* true *or* if B is *not* true. $Z=\overline{A}+\overline{B}$. Note that this truth table is identical to that of Example 1. The logic equation is merely a DeMorgan's transformation of the equations in Example 1. The symbols are equivalent.

EXAMPLE 3 $\overline{Z}=A+B$ or $Z=\overline{A+B}$ and,

EXAMPLE 4 $Z=\overline{A}\bullet\overline{B}$, also share common truth table and are equivalent transformations of each other. The NOT OR form (Example 3) is frequently referred to as NOR.

NOTE

In this manual the logic negation symbol is NOT used.

8-41. Logic Implementation and Polarity Indication

8-42. Devices that can perform the basic logic functions, AND or OR, are called gates. Any device that can perform one of these functions can also be used to perform the other if the relationship of the input and output voltage levels to the logic variables 1 and Ø is redefined suitably.

8-43. In describing the operation of electronic logic devices, the symbol H is used to represent a "high level", which is a voltage within the more-positive (less-negative) of the two ranges of voltages used to represent the binary variables. L is used to represent a "low level", which is a voltage within the less-positive (more-negative) range.

8-44. A function table for a device shows (implicitly or explicitly) all the combinations of input conditions and the resulting output conditions.

8-45. In graphic symbols, inputs or outputs that are active when at the high level are shown without polarity indication. The polarity indicator symbol ◺ denotes that the active (one) state of an input or output *with respect to the symbol to which it is attached* is the low level.

NOTE

The polarity indicator symbol " ◺ " is used in this manual.

EXAMPLE 5 assume two devices having the following function tables.

DEVICE #1
FUNCTION TABLE

A	B	Y
H	H	H
H	L	L
L	H	L
L	L	L

DEVICE #2
FUNCTION TABLE

A	B	Y
H	H	H
H	L	H
L	H	H
L	L	L

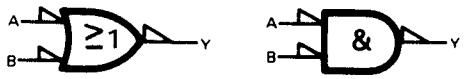
POSITIVE LOGIC. By assigning the relationship H=1, L=Ø at both input and output, Device #1 can perform the AND function and Device #2 can perform the OR function. Such a consistent assignment is referred to as positive logic. The corresponding logic symbols would be:

DEVICE #1

DEVICE #2

NEGATIVE LOGIC. Alternatively, by assigning the relationship H=Ø, L=1 at both input and output, Device #1 can perform the OR function and Device #2 can perform the AND function. Such a consistent assignment is referred to as negative logic. The corresponding logic symbols would be:

DEVICE #1 **DEVICE #2**



8-46. MIXED LOGIC. The use of the polarity indicator symbol (◺) automatically invokes a mixed-logic convention. That is, positive logic is used at the inputs and outputs that do not have polarity indicators, negative logic is used at the inputs and outputs that have polarity indicators.

EXAMPLE 6
FUNCTION TABLE

A	B	Z
H	H	L
H	L	H
L	H	H
L	L	H

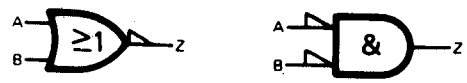
EXAMPLE 7
FUNCTION TABLE

A	B	Z
H	H	L
H	L	L
L	H	L
L	L	H

This may be shown either of two ways:

Note the equivalence of these symbols to examples 1 and 2 and the fact that the function table is a positive-logic translation (H=1. L=Ø) of the NAND truth table, and also note that the function table is the negative-logic translation (H=Ø, L=1) of the NOR truth table, given in Example 3.

This may be shown either of two ways:



Note the equivalence of these symbols to examples 3 and 4 and the fact that the function table is a positive-logic translation (H=1, L=Ø) of the NOR truth table, and also note that the function table is the negative-logic translation (H=Ø, L=1) of the NAND truth table, given in Example 1.

8-47. It should be noted that one can easily convert from the symbology of positive-logic merely by substituting a polarity indicator (◺) for each nega-

tive indicator (o) while leaving the distinctive shape alone. To convert from the symbology of negative-logic, a polarity indication (◺) is substituted for each negation indicator (o) and the OR shape is substituted for the AND shape or vice versa.

8-48. It was shown that any device that can perform OR logic can also perform AND logic and vice versa. DeMorgan's transformation is illustrated in Example 1 through 7. The rules of the transformation are:

1. At each input or output having a negation (o) or polarity (◺) indicator, delete the indicator.
2. At each input or output not having an indicator, add a negation (o) or polarity (◺) indicator.
3. Substitute the AND symbol ⊐ for the OR symbol ⋑ or vice versa.

   These straps do not alter the assumed convention; positive-logic stays positive, negative-logic stays negative, and mixed-logic stays mixed.

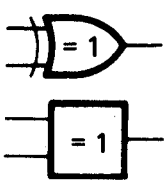
8-49. The choice of symbols may be influenced by these considerations: (1) The operation being performed may best be understood as AND or OR. (2) In a function more complex than a basic gate, the inputs will usually be considered as inherently active high or active low (e.g., the J and K inputs of a J-K flip-flop are active high and active low, respectively). (3) In a chain of logic, understanding and the writing of logic equations are often facilitated if active low or negated outputs feed into active low or negated inputs.

8-50. Other Symbols

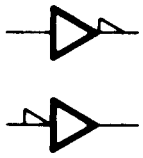
8-51. Additional symbols are required to depict complex logic diagrams, as follows:

Dynamic input activated by transition from a low level to a high level. The opposite transition has no effect at the output.

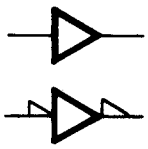
Dynamic input activated by transition from a high level to a low level. The opposite transition has no effect at the output.



Exclusive OR function. The output will assume its indicated active level if and only if one and only one of the two inputs assumes its indicated active level.



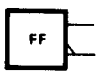
Inverting function. The output is low if the input is high and it is high if the input is low. The two symbols shown are equivalent.



Noninverting function. The output is high if the input is high and it is low if the input is low. The two symbols shown are equivalent.

OUTPUT DELAY. The output signal is effective when the input signal returns to its opposite state.

EXTENDER. Indicates when a logic function increases (extends) the number of inputs to another logic function.



FLIP-FLOP. A binary sequential element with two stable states: a set (1) state and a reset (Ø) state. Outputs are shown in the 1 state when the flip-flop is set. In the reset state the outputs will be opposite to the set state.

RESET. A 1 input will reset the flip-flop. A return to Ø will cause no further effect.

SET. A 1 input will set the flip-flop. A return to Ø will cause no further action.

TOGGLE. A 1 input will cause the flip-flop to change state. A return to Ø will cause no further action.

J INPUT. Similar to the S input except if both J and K (see below) are at 1, the flip-flop changes state.

K INPUT. Similar to the R input (see above).

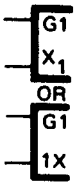
D INPUT (Data). Always dependent on another input (usually C). When the C and D inputs are at 1, the flip-flop will be set. When the C1 is 1 and the D is Ø, the flip-flop will reset.

Address symbol has multiplexing relationship at inputs and demultiplexing relationship at outputs.

8-52. Dependency Notation "C" "G" "V" "F"

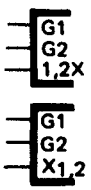
8-53. Dependency notation is a way to simplify symbols for complex IC elements by defining the existence of an AND relationship between inputs, or by the AND conditioning of an output by an input without actually showing all the elements and interconnections involved. The following examples use the letter "C" for control and "G" for gate. The dependent input is labeled with a number that is either prefixed (e.g., 1X). They both mean the same thing. The letter "V" is used to indicate an OR relationship between inputs or between inputs and outputs with this letter (V). The letter "F" indicates a connect-disconnect relationship. If the "F" (free dependency) inputs or outputs are active (1) the other usual normal conditions apply. If one or more of the "F" inputs are inactive (Ø), the related "F" output is disconnected from its normal output condition (it floats).

The input that controls or gates other inputs is labeled with a "C" or a "G", followed by an identifying number. The controlled or gated input or output is labeled with the same number. In this example, "1" is controlled by "G1".



When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.

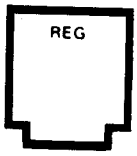
If a particular device has only one gating or control input then the identifying number may be eliminated and the relationship shown with a subscript.



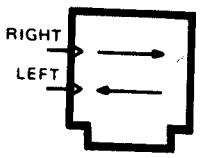
If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example "X" is controlled by "G1" and "G2".

8-54. Control Blocks

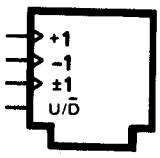
8-55. A class of symbols for complex logic are called control blocks. Control blocks are used to show where common control signals are applied to a group of functionally separate units. Examples of types of control blocks follow.



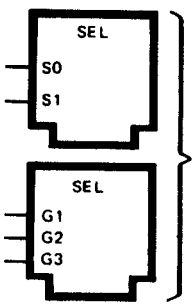
Register control block. This symbol is used with an associated array of flip-flop symbols to provide a point of placement for common function lines, such as a common clear.



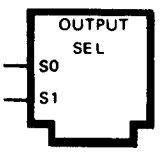
Shift register control block. These symbols are used with any array of flip-flop symbols to form a shift register. An active transition at the inputs causes left or right shifting as indicated.



Counter control block. The symbol is used with an array of flip-flops or other circuits serving as a binary or decade counter. An active transition at the +1 or −1 input causes the counter to increment one count upward or downward, respectively. An active transition at the +1 input causes the counter to increment one count upward or downward depending on the input at an up/down control.



Selector control block. These symbols are used with an array of OR symbols to provide a point of placement for selection (S) or gating (G) lines. The selection lines enable the input designated Ø,1, ... n of each OR function by means of a binary code where SØ is the least significant digit. If the 1 level of these lines if low, polarity indicators (◺) will be used. The gating lines have an AND relation with the respective input of each OR function: G1 with the inputs numbered 1, G2 with the input numbered 2, and so forth. If the enabling levels of these lines is low, polarity indicators (◺) will be used.



Output selector control block. This symbol is used with a block symbol having multiple outputs to form a decoder. The selection lines enable the output designated Ø, 1, ... n of each block by means of a binary code where SØ is the least significant digit. If the 1 level of these lines is low, polarity indicators (◺) will be used.

8-56. REPAIR TECHNIQUES

8-57. Disassembly and Reassembly

8-58. The following pages provide procedures which describe how to disassemble the 5006A Main Cabinet, Data Probe, and Timing Pod, allowing access and/or removal of the printed circuit board assemblies. Reassembly is essentially the reverse of the disassembly procedures.

CAUTION

The 5006A containes metric and English threaded hardware. Screws in the 5006A that appear to have Phillips heads are actually Pozidrive heads, as identified by marks between the four slots in the head of the screw. When servicing the 5006A, use only Pozidrive type screwdrivers in order to avoid damage to the screws or screwdriver.

8-59. The following tools are required to disassemble the 5006A.

a. Large Pozidrive screwdriver
b. Small Pozidrive screwdriver
c. Small Flat-bladed screwdriver
d. Needle-nose pliers
e. Solder-aid tool
f. Nutdriver, 9/32"

8-60. Before performing any disassembly or reassembly, be sure that the front panel POWER switch is in the off (out) position, and that the line power cord is removed from the rear panel connector.

WARNING

LINE VOLTAGE IS EXPOSED WITHIN THE 5006A ON BOTH, THE TOP AND THE BOTTOM OF THE CIRCUIT BOARD, EVEN WHEN THE POWER SWITCH IS SET TO OFF. REMOVAL OF THE POWER CORD IS NECESSARY TO FULLY UNPOWER THE INSTRUMENT.

8-61. MAIN CABINET DISASSEMBLY

a. Remove bottom feet. Remove front and rear cabinet bottom feet.

b. Remove trim strip. Using a small flat-bladed screwdriver or X-acto knife tip, gently lift and remove the adhesive type trim strip from the front left side of the cabinet.

c. Remove rear panel feet. Using a large pozi-driv screwdriver, remove two rear panel feet.

d. Remove carrying strap. Using a large pozi-driv screwdriver, remove the carrying strap retainer on the front right side of the cabinet.
Remove the carrying strap.

e. Remove top cover. Turn the instrument upside-down and remove the four pozidriv screws recessed in the bottom cover. Turn the instrument right side up and remove the top cover.

f. Remove spacers. There are four black spacers, shaped like tubes, approximately 5 cms (2.0 inches) long, in each corner of the instrument. Remove all four spacers.

g. Remove bottom cover. The instrument is secured to the bottom cover with two pozi-driv screws, located at the center and right rear area of the A1 Main Assembly. See *Figure 8-2.* Remove both screws. Lift straight up on both rear panel and front panels, sliding the A1 Assembly up and free from the bottom cover.

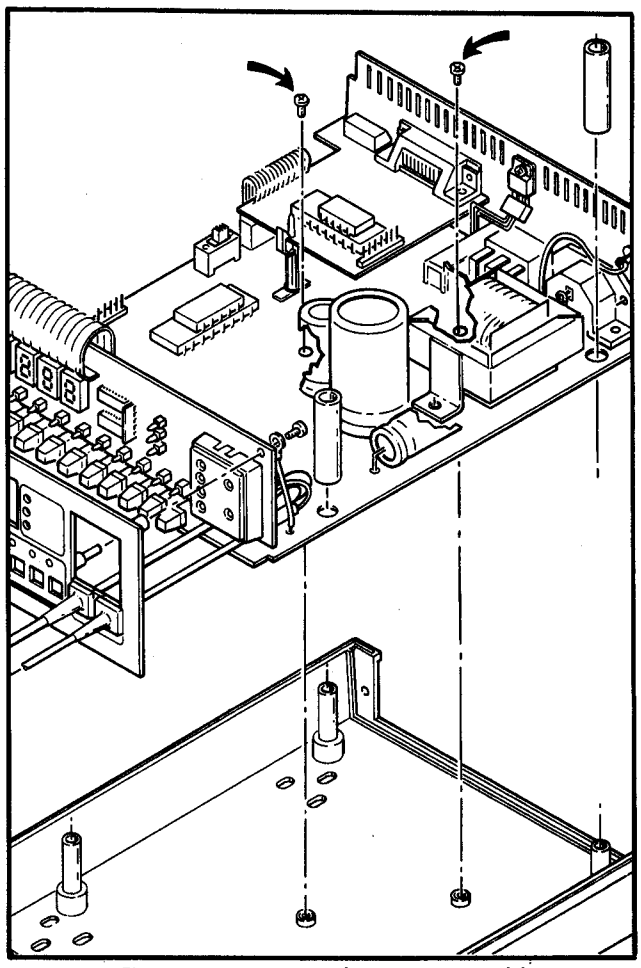


Figure 8-2. Main Cabinet Disassembly

8-62. DISASSEMBLY OF INTERFACE, FRONT PANEL AND REAR PANEL

a. Remove A4/A5 Interface assembly. Using a 9-32 nutdriver, remove the black interface connector mounting studs, securing the interface assembly (A5) to the rear panel. (For A4 use a pozidriv.) Disconnect the 14-line ribbon cable connecting the interface assembly to the A1 assembly at A1J2. Pull the white nylon standoff catch away from the pc board and lift the interface assembly up and free of the A1 assembly.

b. Remove Front Panel from A2 Display Assembly. Using a small posidriv screwdriver, remove the single screw from the inside top edge (top left from solder side of A2 pc board) of the Display/Front Panel assembly. Using needle-nose pliers, remove the three spring retainers securing the A2 pc board to front panel mounting studs. This should free the A2 Display Assembly from the front panel. Care must be taken when handling the A1 and A2 pc board assemblies, as they are connected together by a flat ribbon cable, soldered at both ends. The Timing Pod and Data Probe cable strain relief boots may be removed from the front panel by sliding upward. Be sure when reassembling, that the cables are positioned correctly, with the Data Probe cable to outside (right). The front panel window may be removed by sliding to the left.

c. Remove Rear Panel. Remove the two nylon rivets, securing the LINE INPUT connector to the rear panel. These rivets can be removed using the tip of a solder aid tool, pressing in on the inside end of the center post within the fastener, until it pops out. Replace it by installing rivet, then pressing the center post in with a flat-bladed screwdriver until flush. Remove the three-wire cable assembly connecting rear panel mounted voltage regulator U27 to the A1 Main Assembly. Remove the ground wire after de-soldering it with a soldering iron. This should free the rear panel from the A1 Main Assembly. Be sure when reassembling, that the cable connector is positioned correctly. The cable wires should connect directly to the regulator as if no cable were there. When installed correctly, there should be no twist in the cable. See *Figure 8-3.*

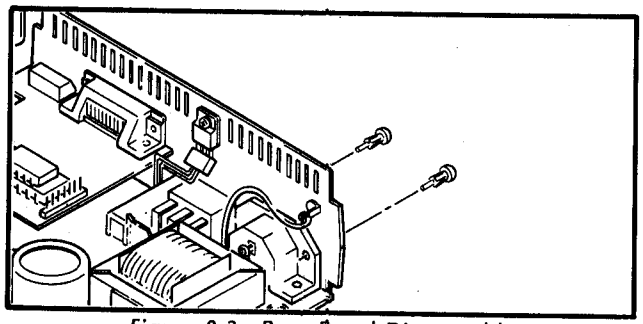


Figure 8-3. Rear Panel Disassembly

8-63. DATA PROBE DISASSEMBLY

a. To disassemble the Data Probe, unscrew the Data Probe tip and pull off the red window. Slide the bottom probe body half off first (this is the probe body half without the ground pin or switch). Lift the top probe body off, being careful not to bend the ground pin which protrudes slightly through the probe body half. Note the position of the probe switch key, which may now be removed. The A3 Data Probe Assembly printed circuit board can be separated from the cable assembly by removing the two small screws securing the pc board to the crimped cable strain relief. Disconnect the pc board by firmly grasping the cable boot while gently lifting the PC board, rocking it side to side until it clears the stops on the boot. See *Figure 8-4.*

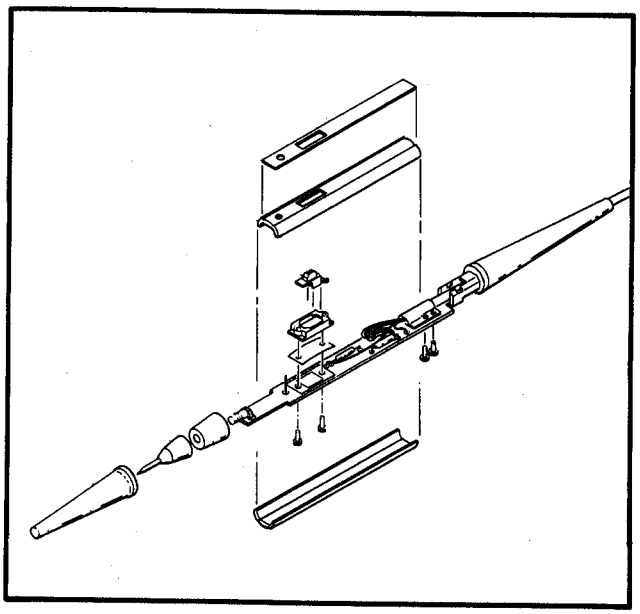


Figure 8-4. Data Probe Disassembly

8-64. TIMING POD DISASSEMBLY

a. The Timing Pod halves are secured together by four locking retainers, two located on either side of the pod. To disassemble the pod, insert the tip of a small flat-bladed screwdriver, pressing in on the retainer while gently separating the pod halves. Note the positions of the wire colors as a reminder for reassembly; green = START/ST/SP/, red = STOP/QUAL, yellow = CLOCK, and black ⊥ . See *Figure 8-5.*

8-65. INSTRUMENT REASSEMBLY

8-66. Reassembly procedures are essentially the reverse of the disassembly procedures.

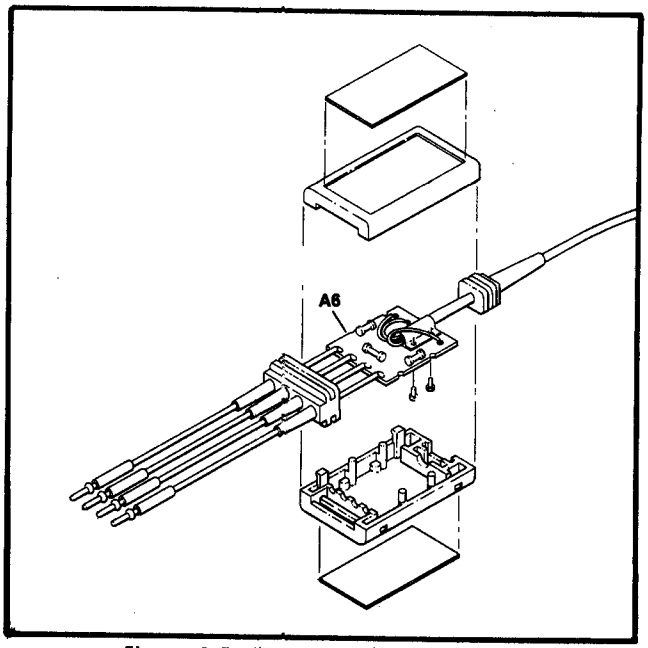


Figure 8-5. Timing Pod Disassembly

8-67. 5006A THEORY OF OPERATION

8-68. Introduction

8-69. The following paragraphs provide the theory of operation for the 5006A Signature Analyzer. The theory begins with a block level description which introduces each major stage of the instrument, describing its function or purpose. The block level discussion references the block diagram in *Figure 8-6.*

8-70. Following the block level description is the detailed circuit theory. The detailed circuit theory describes the purpose, devices, input and output signals, and circuit operation for each stage.

8-71. Block Level Description

8-72. The 5006A is a Signature Analyzer, featuring remote programmability via either HP-IB or HP-IL (depending on installed optional interface). The instrument also generates a Composite Signature measurement, representative of the signatures stored in on-board memory. The stored signatures are chosen by the operator, and identified as triggered signatures by pressing the Data Probe switch. The last 32 stored signatures can be reviewed, modified, replaced, or removed.

8-73. The 5006A can make SA measurements in either Normal or Qualified modes, on TTL or CMOS circuitry. With proper stimulus, the instrument will take and display signatures as fast as possible. Depending on the mode invoked by a remote controller, it may also send each of these signatures to the remote interface. The display is subject to a 100 ms stretching period. This stretching period means that any given signature (not measurement) will be displayed for at least 100 ms, before being replaced by another signature. If a mixture of stable and unstable signatures occurs, the instrument may display both stable and unstable signatures.

8-74. The CENTRAL CONTROL UNIT uses a microcomputer, which contains RAM and ROM. The operational instructions for the instrument are stored in ROM, within the microcomputer. The CENTRAL CONTROL UNIT monitors and directs the overall instrument operation. The primary functions performed by the microcomputer include the movement and display of data, enabling of measurements, display of messages (Error and Failure), and the sending of data to the remote interface. All updating and multiplexing of the display and scanning of the KEYBOARD MATRIX are done in the microcomputer, as well as generation of the self-test stimuli. In operation, measurement function and polarities are selected (in local) via the front panel KEYBOARD. The microcomputer scanes the KEYBOARD MATRIX for any pressed keys.The microcomputer then responds by setting control lines or changing the measurement routine. The microcomputer also controls all front panel indicators and annunciators.

8-75. Signals are input to the 5006A through the Data Probe and Timing Pod. The INPUT VOLTAGE COMPARATORS AND LEVEL SHIFTERS terminate the probe and pod cables, and include compensation circuitry for matching cable impedance. The input signals are compared to references in Input Voltage Comparators. The reference levels are established either by internal TTL references or external CMOS sense input. The comparator outputs are level-shifted from ECL to TTL, then selectively passed or inverted by the EDGE-SELECT and QUAL ENABLE circuits, depending on the chosen polarities and SA mode.

8-76. Measurement timing signals from the Timing Pod drive the GATE CONTROL circuit. The GATE CONTROL circuit is a free-running synchronous state machine, which establishes a window around the data of interest. During the Qualfied mode of operation, the QUAL input may be used to select a subset of the data window, within a measurement window. The GATE HANDSHAKE circuit is a state machine incorporating both synchronous and asynchronous logic. It is used to interface the Central Control Unit to the measurement window. It helps the microcomputer determine when to enable measurements and when measurements are available.

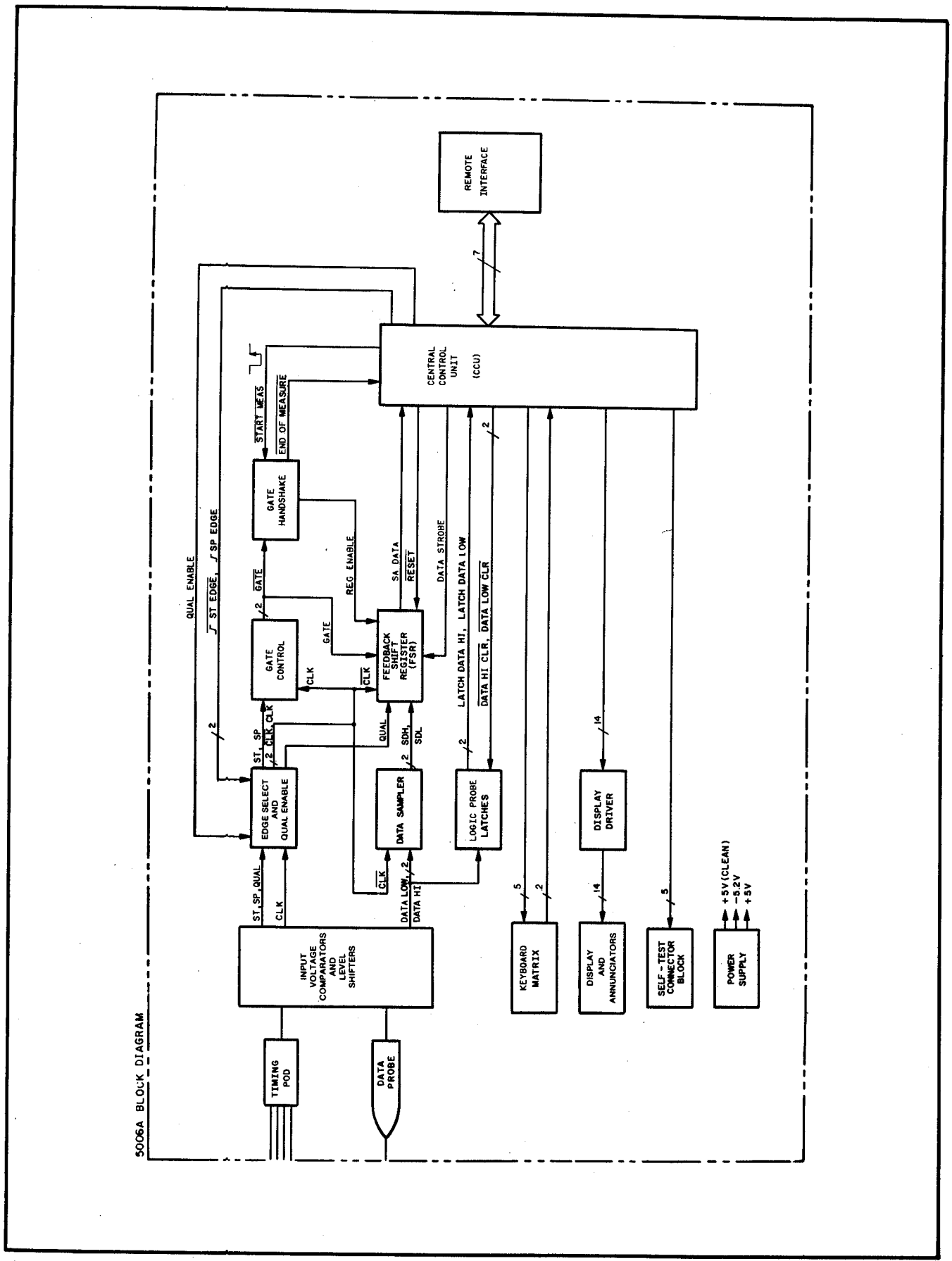


Figure 8-6. 5006A Block Diagram

8-77. Measurement DATA from the Data Probe is routed to the DATA SAMPLER and LOGIC PROBE LATCHES. The DATA SAMPLER circuit examines the incoming data once each clock edge. The synchronous data stream output is then routed to the Feedback Shift Register. The LOGIC PROBE LATCHES are used to monitor the incoming data for the occurrance of highs and lows, which are sent to the microcomputer to direct operation of the Data Probe Logic Indicator Light.

8-78. The Feedback Shift Register (FSR) is a 16-stage serial shift register with selected feedback. During a measurement, a serial stream of data from the DATA SAMPLER is clocked through the FSR by $\overline{\text{CLK}}$, during a window specified by the enable lines GATE, REG ENABLE, and QUAL. At the finish of the gate window, $\overline{\text{CLK}}$ is gated off, leaving a 16-bit residue from the data in the FSR. The microcomputer then sends a burst of 16 clock pulses, via DATA STROBE, to read the contents of the FSR. The 16 bits, output as SA DATA, are formatted by the microcomputer to produce the four-character signature of the original data stream. The four-character signature is then output through DISPLAY DRIVER circuits, to the front panel display.

8-79. DETAILED CIRCUIT THEORY

8-80. The following paragraphs provide the detailed circuit theory for the 5006A. The theory is presented in a format which first lists the Purpose, Circuit Devices, Signals In, Control Signals, and Signals Out, followed by a detailed Circuit Description. This information is repeated for each specific stage of the instrument. The circuit theory and stage names reference the individual schematic diagrams in Figures *8-24* through *8-28*.

8-81. STAGE NAME: Power Supply

PURPOSE:

Generate +5.0 Vdc, -5.2 Vdc, and high current +5.0 Vdc supplies from ac line input voltage. The three regulated dc voltages are used to power all instrument circuitry.

CIRCUIT DEVICES:

S13, Line Voltage Selector Switch (3101-2656)
F1, 0.25 Amp Line Fuse for 115 Vac (2110-0201)
F1, 0.125 Amp Line Fuse for 230 Vac (2110-0318)
T1, Power Transformer (9100-2700)
CR14, Full Wave Diode Bridge Rectifier (1906-0096)
U29, +5 Volt Regulator (1826-0122)
U27, -5.2 Volt Regulator (1826-0215)
U16, Switching Regulator IC (1826-0565)
Q2, PNP silicon (1853-0363)
CR12, 6 volt Zener Diode (1902-0522)
CR13, Diode (1901-0782)
L1, Inductor (9100-3017)

SIGNALS IN:

115 or 230 ac volts, line power input

SIGNALS OUT:

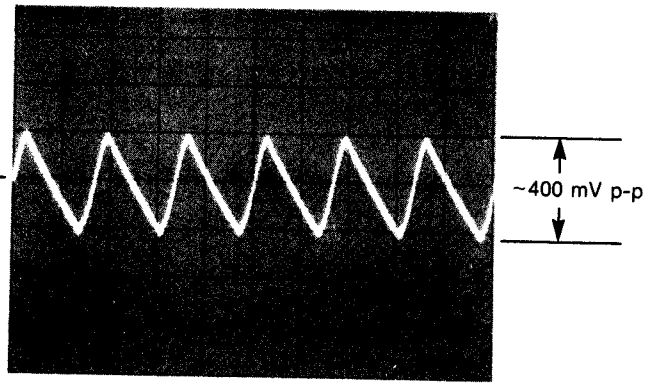
+5.0 Vdc (Clean)
-5.2 Vdc
+5.0 Vdc (High current)

8-82. Circuit Description

8-83. The line power input (either 115V or 230V) is input through connector J4 on the rear panel of the instrument. The ac power is routed through protective Line Fuse F1, to the line voltage select switch S13. The line voltage select switch directs the input ac voltage to the two primary windings of power transformer T1, as follows; when S13 is set to the 115V position, the primary windings are connected in parallel, when S13 is set to the 230V position, the primary windings are connected in series.

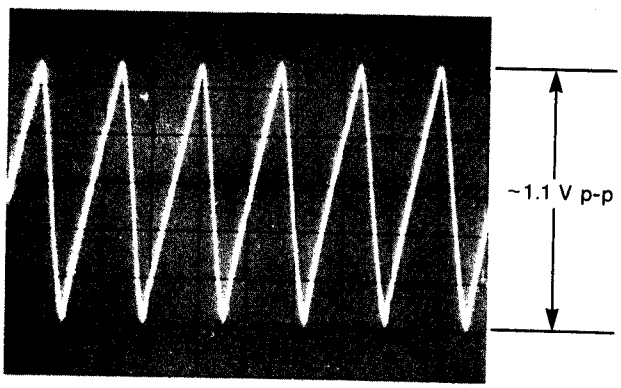
8-84. Power transformer T1 reduces the voltage to about 28 Vac across the center-tapped secondary winding. The stepped-down ac voltage from the secondary is rectified to produce positive and negative dc voltages by two parallel full-wave rectifiers. Diodes CR14 A and B form the positive rectifier, CR14 C and D form the negative rectifier. The secondary center-tap is circuit common. On the positive half of the ac cycle, diodes CR14 A and C are forward biased (on), and CR14 B and D are reversed biased (off). Conduction through CR14 A produces positive half-wave rectified voltage at CR14 pin 1. Conduction through CR14 C produces negative half-wave rectified voltage at CR14 pin 4. During the negative half of the ac cycle the operation is reversed, with CR14 B and D conducting and CR14 A and C off. This yields both positive and negative full wave rectified dc supplies.

8-85. The output of the positive supply is filtered by C40, yielding a dc voltage of approximately 15Vdc, with less than 500 mv peak to peak ripple. The output of the negative supply is filtered by C49, yielding a dc voltage of approximately -15 Vdc, with less than 1.5V peak to peak ripple. *Figure 8-7* shows the typical ripple associated with the positive and negative unregulated supplies.



Ripple voltage, Positive dc supply (unregulated)

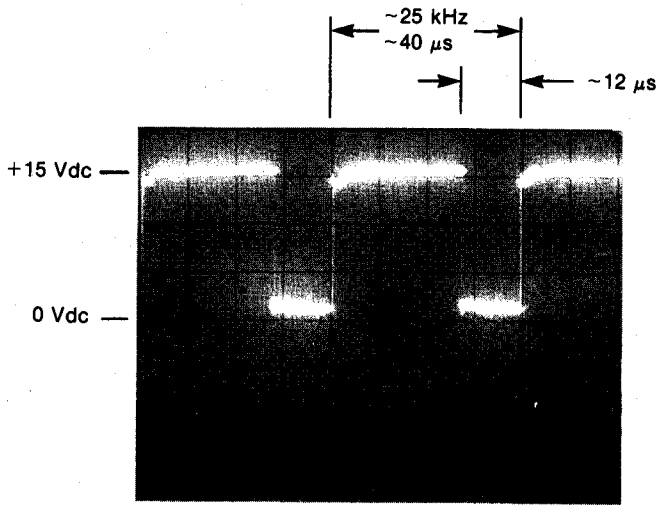
VOLTS/DIV ..... .02
TIME/DIV ..... 5 ms
COUPLING ..... AC
PROBE 10:1
NODE ..... A1 U29, pin 1



Ripple voltage, Negative dc supply (unregulated)

VOLTS/DIV ..... .02
TIME/DIV ..... 5 ms
COUPLING ..... AC
PROBE 10:1
NODE ..... A1 U27, pin 2

Figure 8-7. Unregulated Power Supply Ripple



Switching Output, +5 Vdc Supply

VOLTS/DIV 5
TIME/DIV ..... 10 us
COUPLING ..... DC
PROBE 10:1
NODE ..... A1 U16, pin 8

Figure 8-8. Switching Power Supply Output

8-86. The unregulated +15 volt and -15 volt supplies are routed, through the front panel POWER switch S1(A&B), to the inputs of regulators U29 and U27. U29 and U27 are simple three-terminal voltage regulators which produce relatively clean +5 and -5.2 volt outputs, respectively, but with limited current handling ability. These outputs, further filtered by C39 and C31, are distributed throughout the instrument.

8-87. To more efficiently handle the current requirements of the +5 volt circuitry within the instrument, a second +5 volt regulator circuit is provided. This is a switching type regulator, made up of U16, Q2, and associated circuitry. The heart of this circuit is U16, a pulse width modulation controller, which constantly compares the five volt output to an internal five volt reference, using the difference signal to determine the duty cycle of switching transistor Q2. The pulsed output of Q2 is applied to a resonant RCL network consisting of L1, R17, C18 and C29, where it is smoothed out to a proportional dc level. The switching regulator is driven by the same unregulated positive dc supply as U29.

8-88. In operation, U16 monitors the +5 volt output through the R12/R13 resistive divider, at pin 16. The dc level at pin 16, typically 4.9 volts, controls the variable duty cycle of the ≈25 KHz pulse train output at pins 8 and 11. The pulse train drives the base of switching transistor Q2, through R21. The duty cycle of the pulse train determines the amount of time Q2 is switched on and off, thereby regulating the amount of current supplied by the dc supply. Should the supply be loaded down, the dc level sensed at U16 pin 16 would begin drop. This detected dc shift would prompt U16 to change the duty cycle at pins 8 and 11, remaining low for a longer period of time. This would cause Q2 to be switched on proportionally longer, thus supplying the additional current to the load and restoring the dc level. When the load is removed, the regulator returns to its quiescent operating condition. The waveform in *Figure 8-8* shows the typical output duty cycle of U16 pin 8, under normal load.

8-89. Diode CR12 is an overvoltage protection device, which effectively limits the output dc to 6 volts maximum. Resistor R26 is used to eliminate start-up problems associated with U16 pin 1 falling below ground. Inductor L1 is the primary energy storage device, with diode CR13 providing a current path when Q2 is shut off. The output of the +5 volt switching regulator, labeled "S", supplies the majority of the TTL devices in the instrument, except where sensitivity to power supply noise could be a problem. For these circuits, the linear +5 volt supply, labeled "L" is used.

8-90. STAGE NAME: Input Voltage Comparators and Level Translators

PURPOSE:
Provide input compensation and signal shaping for the input signals from the Data Probe and Timing Pod. The conditioned output pulse trains are then converted from ECL to TTL logic levels.

CIRCUIT DEVICES:
U28, Voltage Comparator (1820-0630)
U25, 26 ECL/TTL Translators (1820-1052)

SIGNALS IN:
1. Data signal input from the Data Probe
2. Start, Stop, Qual and Clock inputs from Timing Pod
3. DC threshold levels from voltage divider circuitry

SIGNALS OUT:
TTL Data, Start, Stop, Clock, and Qual signals

8-91. Circuit Description

8-92. The A1 Main Assembly receives the four main input signals, DATA, START/ST/SP, STOP/QUAL, and CLOCK from the A3 Data Probe and A6 Timing Pod. The three signals from the Timing Pod,START/ST/SP, STOP/QUAL, and CLOCK, are routed to the positive inputs of Input Voltage Comparators U28C, U28D, and U28E, respectively. The Data Probe signal is routed to the positive inputs of U28A and U28B. Variable capacitor C33, combined with resistive network R27, R28, and R29, provide input compensation for the Data Probe. This network can be adjusted (slightly), via C33, to allow the Data Probe input response to be tuned for minimum overshoot and undershoot. Input compensation for the Timing Pod signals is provided by similar (non-adjustable) networks.

8-93. The Input Voltage Comparators are level-sensitive devices, configured to switch output state whenever the level of the input signal (on the positive input) passes through a reference dc level (on the negative input). Two parallel comparators are used for the Data Probe to allow triggering at HI and LO logic levels. Each of the three Timing Pod inputs require only a logic midpoint trigger level.

8-94. The negative references (or trigger) levels for the Input Voltage Comparators are provided by a grouping of RC voltage divider networks. The arrangement of the voltage dividers provides proportionally correct trigger

levels for each of the voltage comparators, using either the internal +5 volt supply or the external CMOS sense input. During normal TTL operation, +5 volts is supplied through CR13 and R51, to a voltage divider network consisting of R44, R52, R55, and R56. The tap points provide the voltage levels for the Data Probe (Pull-to, Hi and Lo), and the Timing Pod (midpoint). Because each of the tap points in the divider provides a voltage source proportional to the supply voltage, a dc level applied to the front panel CMOS input will shift the tap point voltages to CMOS levels.

8-95. The output of each voltage comparator is a digital representation of the the input signal, at ECL logic levels. Each voltage comparator output is then level-shifted by ECL-to-TTL translators U25 and U26.

8-96. STAGE NAME: Edge Select and Qualify Enable

PURPOSE:

Selectively route Timing Pod STOP/ST/SP, STOP/QUAL, and Clock circuits appropriate for the SA function mode, passing either a normal or inverted version of the signals, depending on the instrument POLARITY settings, and to provide a synchronized Qual level for the Feedback Shift Register Clock Selector circuit.

CIRCUIT DEVICES:

U21, Data Selector (1820-1015)
U23, JK Flip-flop (1820-2992)
U20, U22 Exclusive-OR Gates (1820-2692)
U15, AND Gate (1820-2686)

SIGNALS IN:

1. START/ST/SP
2. STOP/QUAL
3. CLOCK

CONTROL SIGNALS:

1. QUAL ENABLE
2. SP EDGE
3. ST EDGE
4. CLK EDGE
5. +QUAL LEVEL

SIGNALS OUT:

1. ST, Edge selected per POLARITY setting
2. SP, Edge selected per POLARITY setting
3. CLK and CLK, edge selected per POLARITY setting
4. QUAL, synchronized to clock

8-97. Circuit Description

8-98. The Edge-Select and Qualify Enable circuit performs three major tasks; to route the correct Timing Pod Start and Stop inputs to the GATE CONTROL circuits (depending on the Signature Analysis mode), to route the Clock and Stop/Qual inputs to the FEEDBACK SHIFT REGISTER, and to perform the edge-select polarity function selecting either the normal or inverted versions of the CLOCK, START, STOP, and QUAL inputs.

8-99. The Timing Pod accepts two timing inputs and a Clock input. The useage of the two inputs depends on the SA mode. In the normal SA mode, Start is received from START/ST/SP input and the Stop is received through STOP/QUAL. During Qualified SA, both Start and Stop are received through the START/ST/SP and Qual is received through STOP/QUAL.

8-100. Data Selector U21 determines the Start and Stop signals for the GATE CONTROL. U21 is a quad A-B selector, which routes either the A or B input of each selector to the Y output, depending on the level of the QUAL ENABLE line (pin 1). The Start signal, from U25D (pin 13), is routed to both inputs (pins 2,3) of U21 Start Selector, insuring that Start will appear at the Y output (pin 4) regardless of the state of QUAL ENABLE. The U21 Stop Selector receives the Start signal on input B (pin 6) and the STOP/QUAL signal, inverted by U25C, on input A (pin 5). During normal SA, QUAL ENABLE will be low, selecting the STOP/QUAL signal at the Y output (pin 7). During Qualified SA, QUAL ENABLE goes high, selecting the Start signal for both Start (pin 4) and Stop (pin 7). These outputs are then applied to X-OR gates U20A and B. The X-OR gates perform an edge-select function by passing either a normal or inverted version of the signal, controlled by level of the ST EDGE and SP EDGE signals. When ST EDGE is low, a normal (or positive) signal is passed, and when ST EDGE is high, an inverted (or negative) signal is passed. The SP EDGE gate operates in the same way.

8-101. The STOP/QUAL signal (inverted) is also routed from U26D (pin 13) through U22, U20, and U15, to Qualifier Synchronizer Flip-flop U23A. U23A synchronizes the input Qual line to the clock. X-OR gate U22C performs the edge-select function on the STOP/QUAL signal, controlled by +QUAL LEVEL at pin 9. When +QUAL LEVEL is low, the signal is passed unchanged, and when +QUAL LEVEL is high, the signal is inverted. The output of U22C (pin 8) is routed through a delay stage, consisting of AND Gate U15B, to the K input (pin 2) of U23A, and to X-OR U20C which inverts the signal and directs it to the J input (pin 3) of U23A. When QUAL ENABLE (pin 4) is high, indicating that the front panel QUAL Function is selected, the input STOP/QUAL signal is clocked coincident with CLK (pin 1) through U23A to the Clock Selector circuit of the FEEDBACK SHIFT REGISTER. When QUAL ENABLE is low, U23A is preset and the output (pin 5) remains high.

8-102. The Clock signal (normal) is routed from U25B (pin 5) through edge-selector U20D, to produce CLK. The CLK signal is then sent to the GATE CONTROL circuit. The Clock signal (inverted) is routed from U26C (pin 12) through edge selector U22D, to produce CLK. The CLK signal is distributed to the Qualifer Synchronizer, GATE HANDSHAKE, FEEDBACK SHIFT REGISTER Clock Selector, and DATA LATCH circuits. The edge-select function is performed by X-OR gates U20D and U22D, controlled by CLK EDGE. When CLK EDGE is low, a normal (or positive) signal is passed, and when CLK EDGE is high, an inverted (or negative) signal is passed.

8-103. STAGE NAME: Gate Control

PURPOSE:
Generate the GATE signal for the Feedback Shift Register, using ST, SP, and CLK.

CIRCUIT DEVICES:
U11, U12 AND-OR Invert Gates (1820-2676)
U13, D-FF (1820-2691)

SIGNALS IN:
1. ST
2. SP
3. CLK

CONTROL SIGNALS:
1. GATE RESET

SIGNALS OUT:
1. GATE
2. $\overline{\text{GATE}}$

8-104. Circuit Description

8-105. The Gate Control is a free-running synchronous state machine driven by the ST, SP, and CLK inputs. The state machine is configured to produce a GATE signal based on the selected edges of the ST and SP input signals, synchronized to CLK. In addition, the circuit provides a network of gate qualifier feedbacks which insure the validity of the GATE signal by allowing events to occur only in a predetermined sequence. This avoids undesirable gate periods potentially triggered by conditions like Stop before Start, Start before end of previous measurement, Start while FSR is being read, etc.

8-106. The ST signal is input to U11 (pins 4, 3) and U12 (pin 5). SP is input to U11 (pins 5,10) and U12 (pin 9). The Gate Control circuit is initially reset by GATE RESET (U13 pins 13, 4). GATE RESET is provided by the microcomputer at power-on and at instrument clear (push CLEAR on the front panel.) ST is clocked through first, while SP is gated off. When ST causes a change in GATE (U13 pin 8), ST is effectively gated off and SP is allowed to clock through. When SP causes a change in GATE, all inputs are gated off until a GATE RESET is received.

8-107. The GATE signal represents the window of time that data, from the Data Probe, will be clocked into the FSR. The output GATE signal is routed to the Clock Selector of the FEEDBACK SHIFT REGISTER (FRS), and to the front panel GATE annunciator circuit. The inverted GATE is used as feedback within the state machine, and output to the Gate Handshake circuit.

8-108. STAGE NAME: Gate Handshake

PURPOSE:
To enable measurements and to notify the microcomputer when a measurement is complete. Interfaces the Central Control Unit (CCU) the Gate Control circuitry.

CIRCUIT DEVICES:
U14, D-FF (1820-2691)
U15, AND Gate (1820-2686)

SIGNALS IN:
1. $\overline{\text{CLK}}$
2. $\overline{\text{GATE}}$

CONTROL SIGNALS:
1. ST MEAS

SIGNALS OUT:
1. REG ENABLE
2. $\overline{\text{END OF MEASURE}}$

8-109. Circuit Description

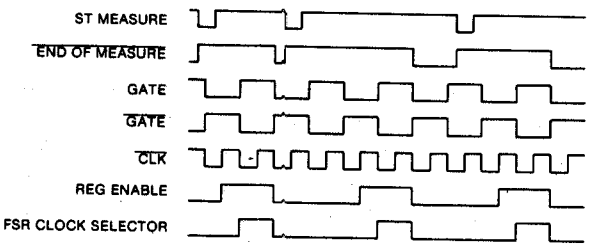
8-110. The Gate Handshake circuit is a state machine incorporating both synchronous and asynchronous logic. It is used by the microcomputer to enable measurements and to determine when measurements are complete.

8-111. The Gate Handshake circuit uses the ST MEAS, GATE, and CLK signals to generate REG ENABLE and END OF MEASURE.

8-112. The measurement sequence is a handshake. A measurement is first enabled by the microcomputer. Clocking of data into the Feedback Shift Register (FSR) is initiated by the ST signal. Clocking of data into the FSR terminates with the end of GATE signal. After all the data has been input, the microcomputer reads the data residue from the FSR, and computes and displays a signature. When the sequence is completed, the microcomputer starts over, enabling another measurement. What is important to realize is that the overall measurement sequence is asynchronous, due to the effective

dead time between measurements required for processing and display of data. The actual gate duration during the measurement, however, is synchronous, to maintain accuracy. The necessary control for a synchronous gate within an asynchronous measurement is performed by the Gate Handshake circuit.

8-113. The state machine generates REG ENABLE, to insure the FSR does not accept data until all measurement processing is complete. END OF MEASURE is generated to alert the microcomputer that all data is received and processing may begin. The basic relationship of the signals is shown in the following diagram.



8-114. When data processing and display is completed, the microcomputer sends ST MEAS, a negative pulse, to clear U14A (pin 1.) Clearing U14A sets END OF MEASURE at U14A(pin 6) high, the rising edge of ST MEAS releases the Clear input of U14 (pin 13). The REG ENABLE , at U14B (pin 9), to be activated by the rising edge of CLK while $\overline{GATE}$, at U14 (pin 12) is high. The logical 1 of REG ENABLE enables the FSR Clock Selector for a time determined by the positive Gate period. When enabled, the FSR Clock Selector inverts and passes CLK pulses, allowing data to be shifted through the FSR. The falling edge of the Gate period disables the Clock Selector. At the same time the rising edge of the $\overline{GATE}$ disables REG ENABLE and generates END OF MEASURE, which remains low until the microcomputer completes it's processing and display, at which time the microcomputer returns a ST MEAS and the signature repeats.

8-115. STAGE NAME: Data Sampler/ Logic Probe Latches

PURPOSE:
Sample data input through Data Probe and monitor transistions of logic states.

CIRCUIT DEVICES:
U23, J-K Flip flop (1820-2992)
U19, D-Flip flop (1820-2691)
U15, AND Gates (1820-2686)
U22, X-OR Gates (1820-2692)
U21, Data Selectors (1820-1015)

SIGNALS IN:
1. DATA HI
2. DATA LOW
3. CLK

CONTROL SIGNALS:
1. RESET
2. DATA HI CLR
3. DATA LOW CLR

SIGNALS OUT:
1. LATCH DATA HI
2. LATCH DATA LOW
3. SDH
4. SDL

8-116. Circuit Description

8-117. Input data from the Data Probe may be HI, (above the high threshold voltage), LOW (below the low threshold voltage), or FLOAT (in-between the two threshold levels). The HI and LOW states trigger Input Voltage Comparators U28B and U28A, respectively. The ECL signals from the Voltage comparators are level-shifted by ECL-to-TTL translators U26B and U26A. The outputs of U26B and U26A go low when respective DATA HI and DATA LOW conditions exist. These signals are routed through X-OR gates U22A and U22B and Data Selector U21, to the J and K inputs of Flip-flop U23B. Flip-flop U23B samples the input data by clocking through whatever data is present at the J and K inputs at the falling edge of CLK. DATA HI is clocked through as high, DATA LOW is clocked through as low, and DATA FLOAT is clocked through at whatever the previous state was. This produces a synchronous data stream, referenced to the sampling rate of CLK. Devices U22, U21, and U15 are used as delays, to match the Data Probe data to the Timing Pod signals.

8-118. The Logic Probe Latches monitor the occurrence (non-occurrence) of ones and zeros in the data stream. This information is passed to the microcomputer to generate the HIGH, DIM, and OFF Logic Light indications in the Data Probe. Signals DATA HI and DATA LOW from U22 (pins 3 and 6) drive the preset inputs (pins 10 and 4) of the D-Flip-flops U19B and A. The Clock and D inputs of both flip-flops are tied high through R15. Negative going DATA HI or DATA LOW pulses causes their respective Q outputs (pins 9 and 5) to go high. The outputs, LATCH DATA HI and LATCH DATA LOW, are routed to the microcomputer, which in turn generates a corresponding PROBE LIGHT (BRIGHT) or PROBE LIGHT (DIM) pulse output. The microcomputer pulse outputs are a minimum of 100 ms long. This pulse-stretching type function insures that activity is recognized by the user even when transitions occur at a very high rate. The microcomputer then resets the Logic Probe Latches by sending DATA HI CLR or DATA LOW CLR.

8-119. PROBE LIGHT (BRIGHT) and PROBE LIGHT (DIM) control the Logic Probe Light Driver by sending: high state to U1 for DIM, high state to U1 and Q1 for BRIGHT, and low states to U1 and Q1 for OFF. The output of U1/Q1 is and sent to drives the LED within the Data Probe.

8-120. STAGE NAME: Feedback Shift Register (FSR)

PURPOSE:

Accept serial input data from the Data Probe and output SA DATA

CIRCUIT DEVICES:

U7,U9,U10 Shift Register (1820-2696)
U8, Shift Register (1820-1303)
U17,U18 Data Selector (1820-1158)
U24, AND-OR Invertor (1820-2676)

CONTROL SIGNALS:

1. DATA STROBE
2. RESET

SIGNALS IN:

1. Sampled DATA HI
2. Sampled DATA LOW
3. REG ENABLE
4. GATE
5. QUAL
6. CLK

SIGNALS OUT:

1. SA DATA

8-121. Circuit Description

8-122. The Feedback Shift Register (FSR) is comprised of four synchronous quad D-Flip-flops, U7, U8, U9, U10, configured as a 16-bit binary shift register (i.e., Q output to D input). Dual And-Or-Invert gates, U17 and U18, provide feedback of selected bits from various stages to form a pseudo-random binary sequence generator. A serial stream of data within a defined gate interval is input at one end of the register. When the entire stream has been input, 16 bits are clocked out of the register to form the data stream signature.

8-123. The normal and complemented data from the Data Sampler is input to the FSR at pins 9 and 1 of U18. Data is clocked through the FSR on the rising edge of GATED CLK, which is produced by Clock Selector circuit U24.

8-124. Clock Selector U24 provides the clock signals which shift data through the FSR. During a GATE window, qualifiers REG ENABLE (pin 13), GATE (pin 1) and QUAL (pin 11) will be high. This allows CLK (pin 12) to be gated through and inverted, producing GATED CLK (pin 8). GATED CLK synchronously moves the data through the FSR for the duration of the GATE window.

8-125. The signature for the data stream is generated from the residue data present in the FSR at the end of the GATE window. Data clocked out of the FSR at U7 (pin 7) during the GATE window is not acknowledged by the microcomputer. At the end of the GATE window, GATED CLK signal is disabled when REG ENABLE and GATE go low, capturing the last 16 bits of the data stream in the FSR. Coincident with the end of GATE, the Gate Handshake circuit generates END OF MEASURE, which signals the microcomputer that the measurement is complete. The microcomputer responds by sending out DATA STROBE to read the FSR data. DATA STROBE is a burst of 16-clock pulses, gated through Clock Selector U24. These 16 clocks serially push the contents of the FSR out U7 (pin 7) as SA DATA, to the microcomputer U6 (pin 37).

8-126. STAGE NAME: Central Control Unit, Keyboard Matrix, and Display Driver

PURPOSE:

Movement and display of information.

CIRCUIT DEVICES:

U6, Microcomputer
U5, Octal D-Flip flop/Latches (1820-2641)
U3, U4, Octal D-Flip flop/Latches (1820-1997)

SIGNALS IN:

1. Data Bus I/O
2. Control Bus I/O
3. Interface Bus I/O

SIGNALS OUT:

1. Control Signals
2. Interface Bus I/O
3. Display Driver Bus

8-127. Circuit Description

8-128. The instrument Central Control Unit (CCU) is based on an LSI microcomputer, U6, which contains 4K bytes of ROM, 128 bytes of RAM, and a hardware timer.

The microcomputer features four 8-bit I/O ports, as well as five device control lines. The CCU communicates with the rest of the instrument through the 32 bidirectional I/O lines and the external interrupt.

8-129. The primary function performed by the Central Control Unit is the movement of measurement data, generation of signature, and subsequent display of signature. Additionally, the CCU controls all front panel annunciators, and monitors the keyboard matrix for a keypress. It controls the enabling of signature measurements, the display of error messages, and the transfer of data to the interface. It also generates the self-test stimuli.

8-130. Many of the I/O lines are multiplexed, allowing two and sometimes three separate signals to time-share a line. The multiplexed lines are routed through data latches U4, U5, and U3. The data latches store selected data, controlled by the microcomputer via DLE1, DLE2, and DLE3. Once stored, these outputs are distributed as control signals throughout the instrument.

8-131. The keyboard consists of ten momentary contact keys and one latching power on/off key. The momentary keys are configured in a matrix, which is sequentially scanned by microcomputer. A keypress is detected by a corresponding change in the Y0 or Y1 matrix output. The Y0 and Y1 signals are returned to the microcomputer, and are used to select polarities and operating modes in the instrument.

8-132. The Self-test circuit consists of six lines, four of which go to a block of self-test connectors on the front panel, and two which go to internal test pins (J1.) In self-test operation stimulus patterns are placed on these lines. By connecting the pod and probe wires to these points, the internal hardware of the instrument may be exercised.

8-133. STAGE NAME: Remote Interface/ I/O Port

PURPOSE:
Interface communication with external controller and CCU

CIRCUIT DEVICES:
U6, Microcomputer

SIGNALS IN:
1. Handshake IN
2. Handshake OUT
3. Direction
4. INT. DATA (MSB)
5. INT. DATA (NMSB)
6. INT. DATA (NLSB)
7. INT. DATA (LSB)

SIGNALS OUT:
1. Handshake IN
2. Handshake OUT
3. Direction
4. INT. DATA (MSB)
5. INT. DATA (NMSB)
6. INT. DATA (NLSB)
7. INT. DATA (LSB)

8-134. Circuit Description

8-135. The (optional) remote interface consists of one (of two) plug-in boards; one dedicated to HP-IB, one dedicated to HP-IL. Both boards contain a microcomputer, and all the necessary electronics for matching signal levels. The interface boards connect to the A1 Main board through a 14-line ribbon cable and connector. The interface boards connect to an external bus or loop through appropriate HP-IB or HP-IL connectors. Bus protocols, output message formating, and input message preprocessing are done by the microcomputer on the interface board.

8-136. The A5 HP-IB Interface Assembly allows remote control of the 5006A via the HP-IB. Bi-directional data registers U1 and U2 transfer information on data lines DIO1 through DIO8, and on the bus management lines. Information is received, processed, and output through microprocessor U5. Address selection is determined by the settings on Address Switch S1.

8-137. The HP-IL interface chip U1 converts messages back and forth between the parallel form used by the microprocessor and the serial form used by the HP-IL loop.

8-138. STAGE NAMES: Data Probe/ Timing Pod

PURPOSE:
Input circuits for data and timing signals.

CIRCUIT DEVICES:
DS1, LED (1990-0517)

SIGNALS IN:
1. Data from UUT
2. PULL-TO Voltage
3. VCC

4. Probe Light
5. START/ST/SP
6. STOP/QUAL
7. CLOCK
8. (Ground)

SIGNALS OUT:

1. DATA
2. Probe Switch
3. START/ST/SP
4. STOP/QUAL
5. CLOCK

8-139. Circuit Description

8-140. The A3 Data Probe contains the 10:1 Passive Divider and Logic State Indicator LED. Digital signals input to the 5006A through the probe tip of the Data Probe. The signals are attenuated by a factor of 10, by the passive divider network consisting of R1, C1, in conjunction with A1 R27 and R29. CR1 is the Logic State Indicator, which is driven by the Data Probe Light Driver circuit on A1. The LED is turned on BRIGHT when logic high states are present, turned on DIM when logic high impedance states are present, and turned OFF when logic low states are present at the probe tip. The high impedance state output is achieved via R2 and the PULL-TO voltage. Momentary pushbutton S1 is used as an interactive operator control, providing a direct poll to the microcomputer. The instrument firmware utilizes the probe switch response for several different functions, including measurement triggering, Signature Memory scan and edit, and Self-test.

8-141. The A6 Timing Pod receives the three major timing signals; START/ST/SP, STOP/QUAL, and CLOCK. Each of the three signals passes through a passive divider circuit comprised of an RC network on A6 in conjuntion with a series-parallel network on A1. The divider networks attenuate the input signals by a factor of ten.

8-142. TROUBLESHOOTING

8-143. Introduction

8-144. The HP 5006A is a microcomputer based system. The majority of instrument circuitry consists of digital logic configurations. Troubleshooting is accomplished by using the instruments display responses, signature and voltage measurements, to guide you through an indicated troubleshooting tree.

8-145. Troubleshooting Flowchart

8-146. Specific troubleshooting information is provided through various troubleshooting trees. The basic troubleshooting technique is illustrated in the Overall Troubleshooting Flowchart, *Figure 8-9*. This flowchart shows how to best interpret the indications provided by the Power-up Self-check, Error and Failure messages, and Display to initially isolate the trouble. The Overall Troubleshooting Flowchart should help direct the technician to the proper troubleshooting trees, shown in *Figures 8-9* and *8-10*. The meaning of Error and Failure messages, and subsequent recommended action is listed in *Table 8-3*.

8-147. Built-in Troubleshooting Aids

8-148. The 5006A provides two built-in diagnostic routines and a service switch, which are integrated into the troubleshooting scheme. The two diagnostic routines are:

- Power-Up Self-Check - Occurs automatically during power-up.
- SELF-TEST - Initiated by completing external connections.

8-149. Troubleshooting Procedure

8-150. Troubleshooting begins with the initial application of power to the instrument, which automatically initiates the Power-Up Self-Check. As shown in the Overall Troubleshooting Flowchart in *Figure 8-7*, the instrument responses to power-up are categorized into five basic displays; Blank display, Error message, Fail message, Heiroglyphics, or Correct. Follow the path indicated by the Overall Troubleshooting Tree. Depending on the response of the instrument, the symptoms may lead directly to suspect components, or request the SELF-TEST. This test requires connecting the Data Probe and Timing Pod inputs to the front panel Self-test connector block, allowing the input circuitry, cables, and comparators to be checked without additional equipment.

8-151. The troubleshooting procedure may further request to switch the S12 on the A1 main board to the SERVICE position. This will provide stable signatures for troubleshooting purposes. The display will show F-32 which is to be ignored. All the correct signatures are provided in *Figure 8-22*.

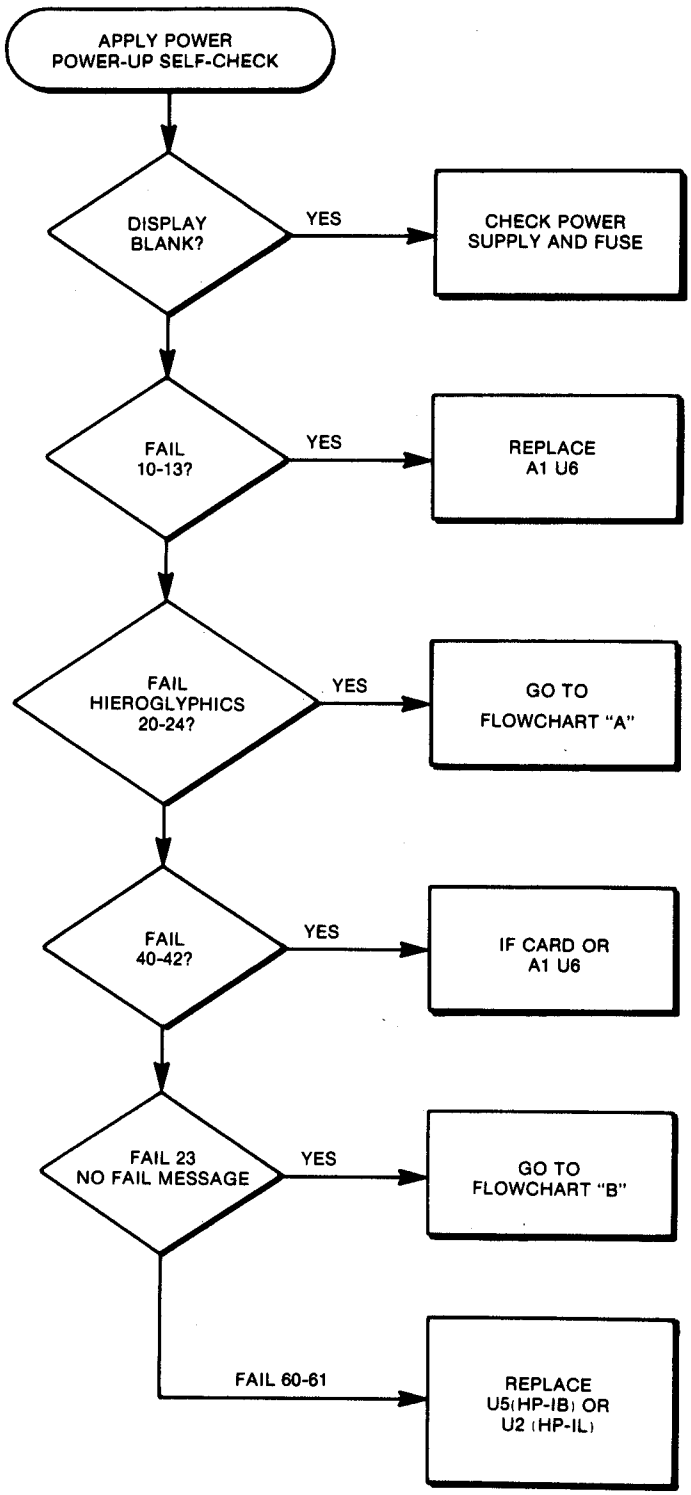
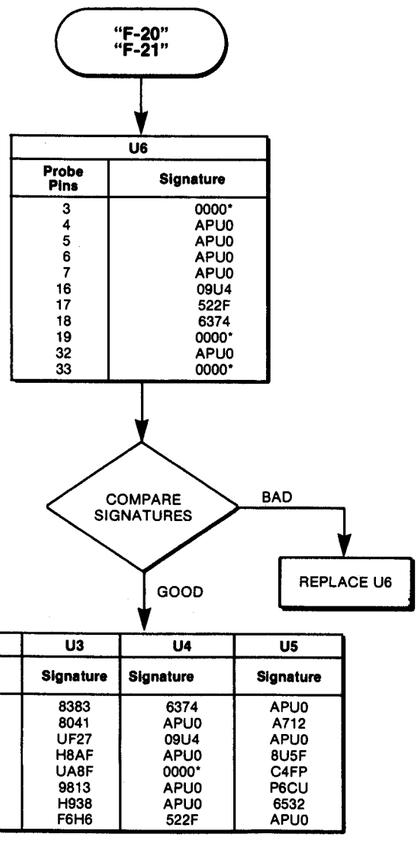


Figure 8-9. Overall Troubleshooting Tree

SET-UP FOR TAKING SIGNATURES

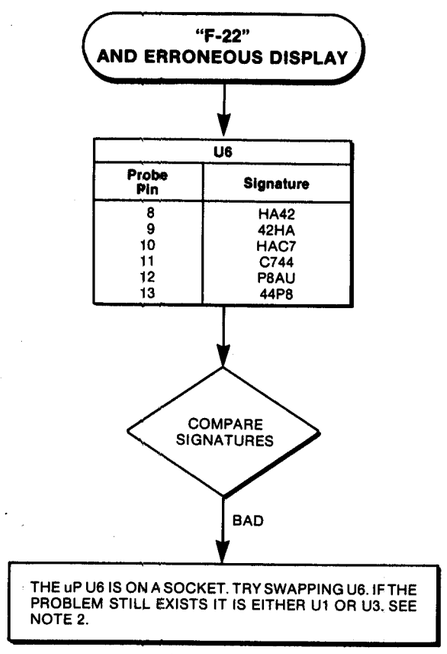
CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.



U6	
Probe Pins	Signature
3	0000*
4	APU0
5	APU0
6	APU0
7	APU0
16	09U4
17	522F
18	6374
19	0000*
32	APU0
33	0000*

	U3	U4	U5
Probe Pin	Signature	Signature	Signature
2	8383	6374	APU0
5	8041	APU0	A712
6	UF27	09U4	APU0
9	H8AF	APU0	8U5F
12	UA8F	0000*	C4FP
15	9813	APU0	P6CU
16	H938	APU0	6532
19	F6H6	522F	APU0

NOTE 1. IF ANY OF THE LINES MENTIONED ABOVE IS LOW OR HIGH BUT SHOULD HAVE SOME ACTIVITY ON IT, THE FAULT COULD BE IN U3, U4, U5 OR U6. THEREFORE DO NOT REPLACE U6. INSTEAD TRY TO LOCATE A SHORT WITH THE HELP OF A LOGIC PULSER AND A CURRENT TRACER.


"F-22"
AND ERRONEOUS DISPLAY
COMPARE SIGNATURES
BAD
THE uP U6 IS ON A SOCKET. TRY SWAPPING U6. IF THE PROBLEM STILL EXISTS IT IS EITHER U1 OR U3. SEE NOTE 2.

U6	
Probe Pin	Signature
8	HA42
9	42HA
10	HAC7
11	C744
12	P8AU
13	44P8

NOTE 2. IF THE LINES PROBED ARE EITHER HIGH OR LOW, THEN THE PROBLEM COULD BE IN U1 OR U3 ON THE DISPLAY BOARD. USE THE LOGIC PROBE AND A CURRENT TRACER TO LOCATE THE BAD IC.

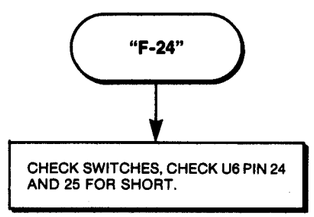
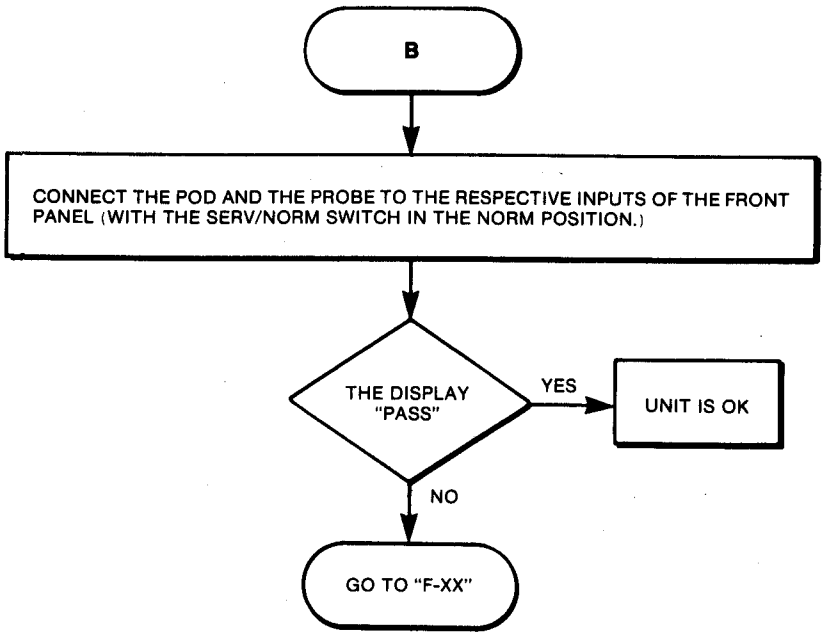
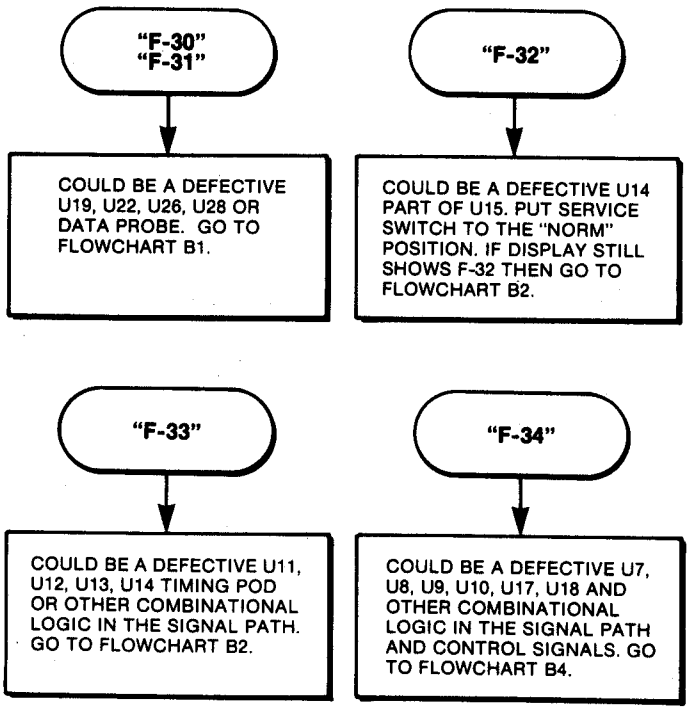


Figure 8-10. Troubleshooting FlowChart A


B
CONNECT THE POD AND THE PROBE TO THE RESPECTIVE INPUTS OF THE FRONT PANEL (WITH THE SERV/NORM SWITCH IN THE NORM POSITION.)
THE DISPLAY "PASS"
YES
UNIT IS OK
NO
GO TO "F-XX"

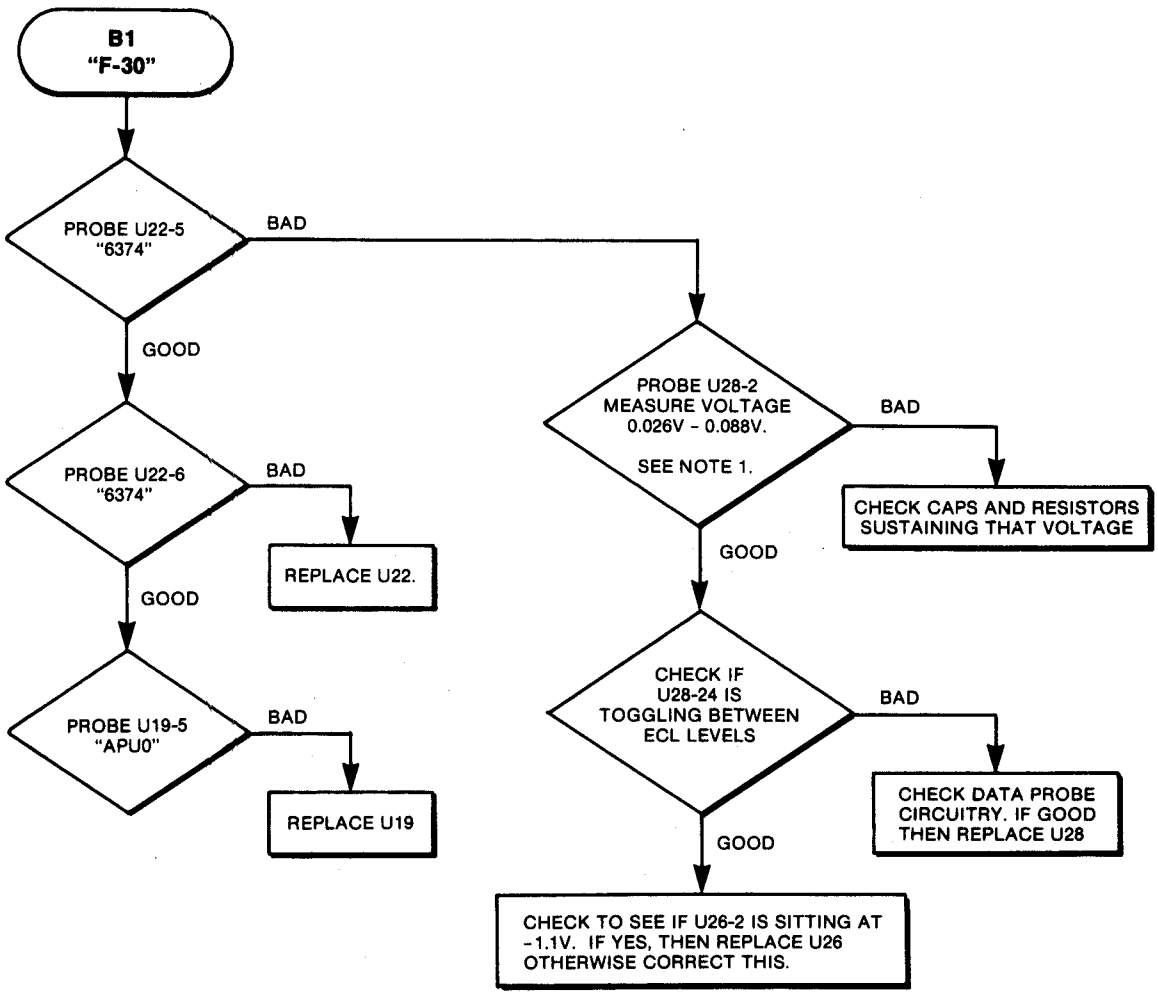

"F-30"
"F-31"
COULD BE A DEFECTIVE U19, U22, U26, U28 OR DATA PROBE. GO TO FLOWCHART B1.
"F-32"
COULD BE A DEFECTIVE U14 PART OF U15. PUT SERVICE SWITCH TO THE "NORM" POSITION. IF DISPLAY STILL SHOWS F-32 THEN GO TO FLOWCHART B2.
"F-33"
COULD BE A DEFECTIVE U11, U12, U13, U14 TIMING POD OR OTHER COMBINATIONAL LOGIC IN THE SIGNAL PATH. GO TO FLOWCHART B2.
"F-34"
COULD BE A DEFECTIVE U7, U8, U9, U10, U17, U18 AND OTHER COMBINATIONAL LOGIC IN THE SIGNAL PATH AND CONTROL SIGNALS. GO TO FLOWCHART B4.

BEFORE GOING TO THE FLOWCHARTS, CHECK THE SIGNATURES ON THE CONTROL LINES LEAVING U3, U4 AND U5. TO DO THIS CHECK, FOLLOW THE PROCEDURE GIVEN FOR "F-20" AND "F-21". THIS WILL GIVE US CONFIDENCE IN OUR CONTROL LINES.

Figure 8-11. Troubleshooting Flowchart B

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.



NOTE 1. THE VOLTAGE AT THE U28 PIN 2 IS ALWAYS LESS THAN THE VOLTAGE AT U28 PIN 13 AND 14. AND THE VOLTAGE AT U28 PIN 13 IS ALWAYS LESS THAN THE VOLTAGE AT U28 PIN 21.

Figure 8-12. Troubleshooting Flowchart B1 (F-30)

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

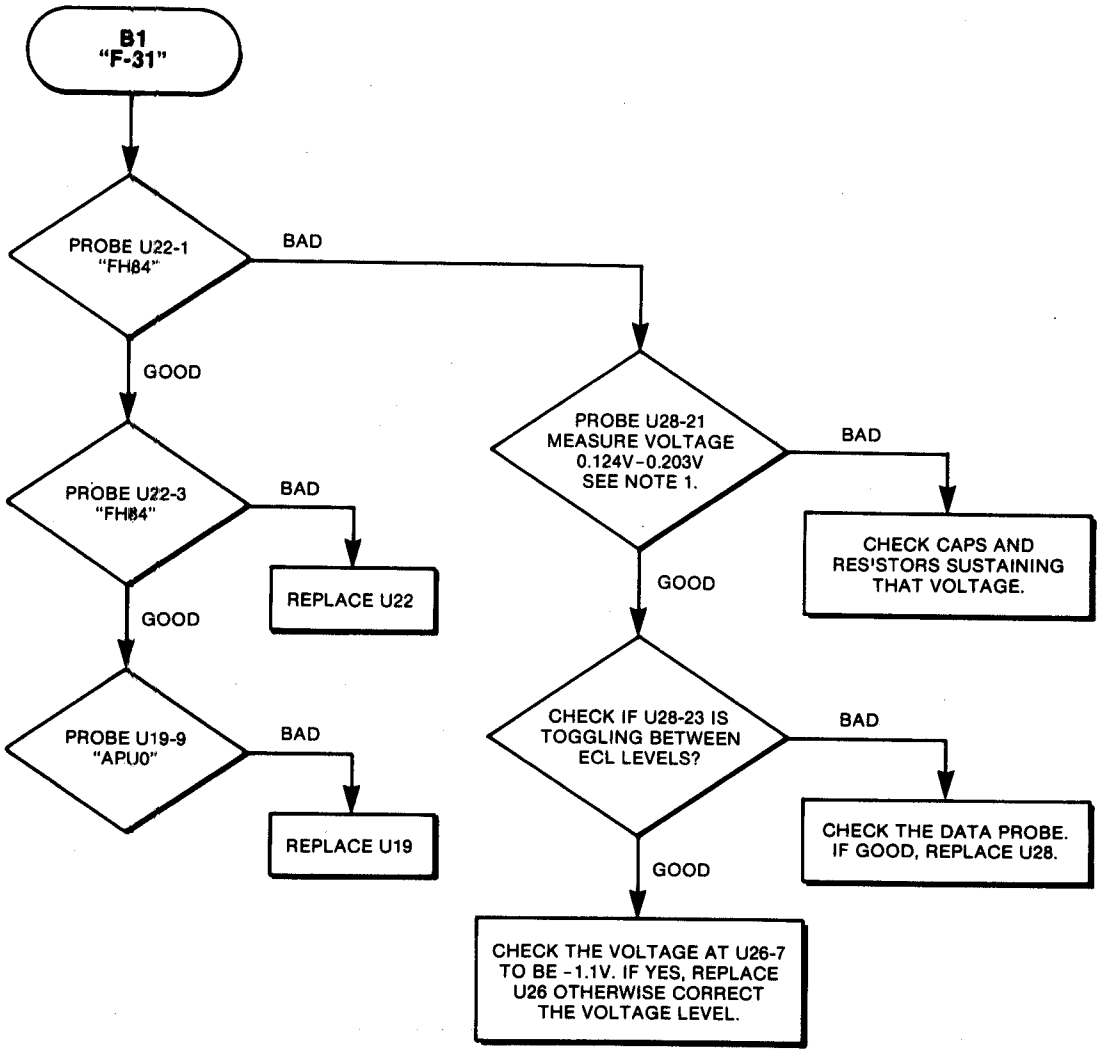


Figure 8-13. Troubleshooting Flowchart B1 (F-31)

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

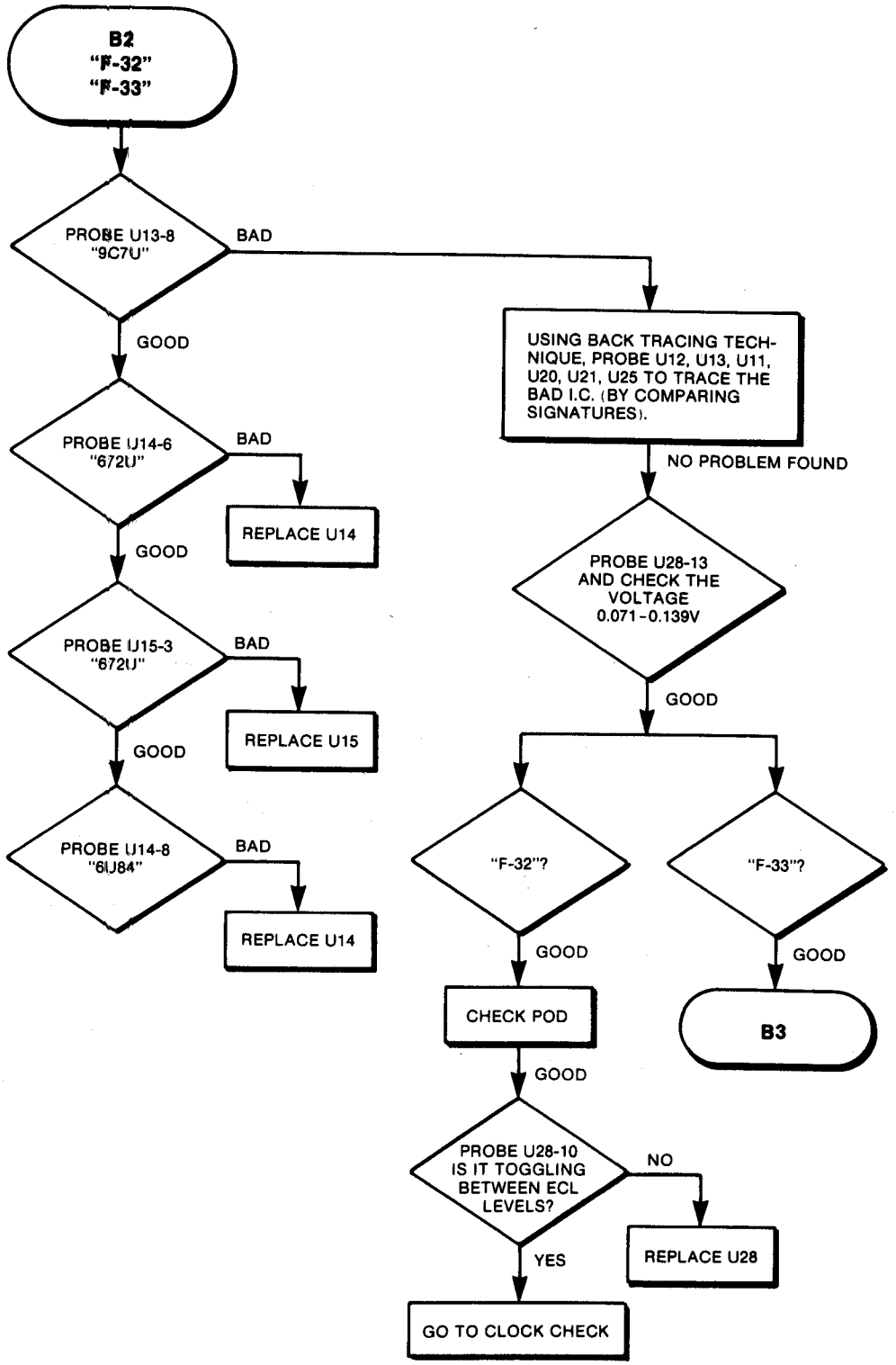


Figure 8-14. Troubleshooting Flowchart B2

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

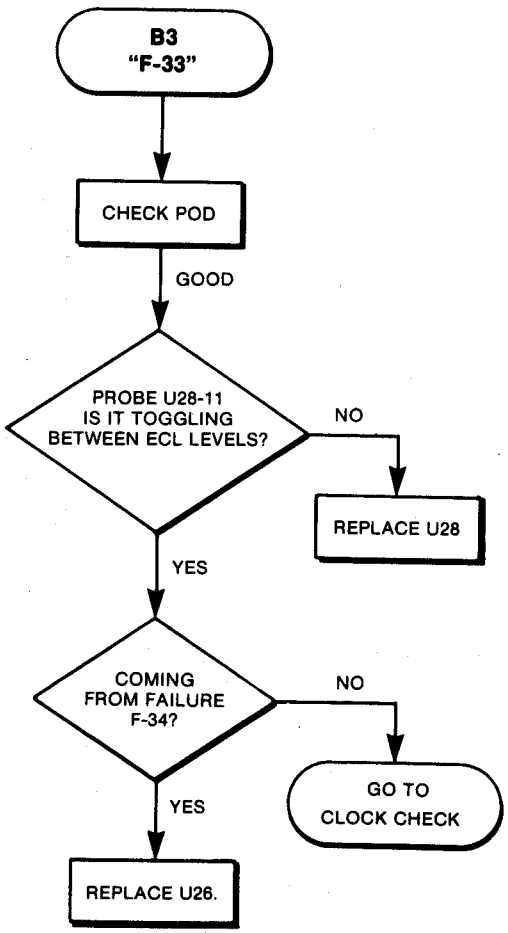


Figure 8-15. Troubleshooting Flowchart B3

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

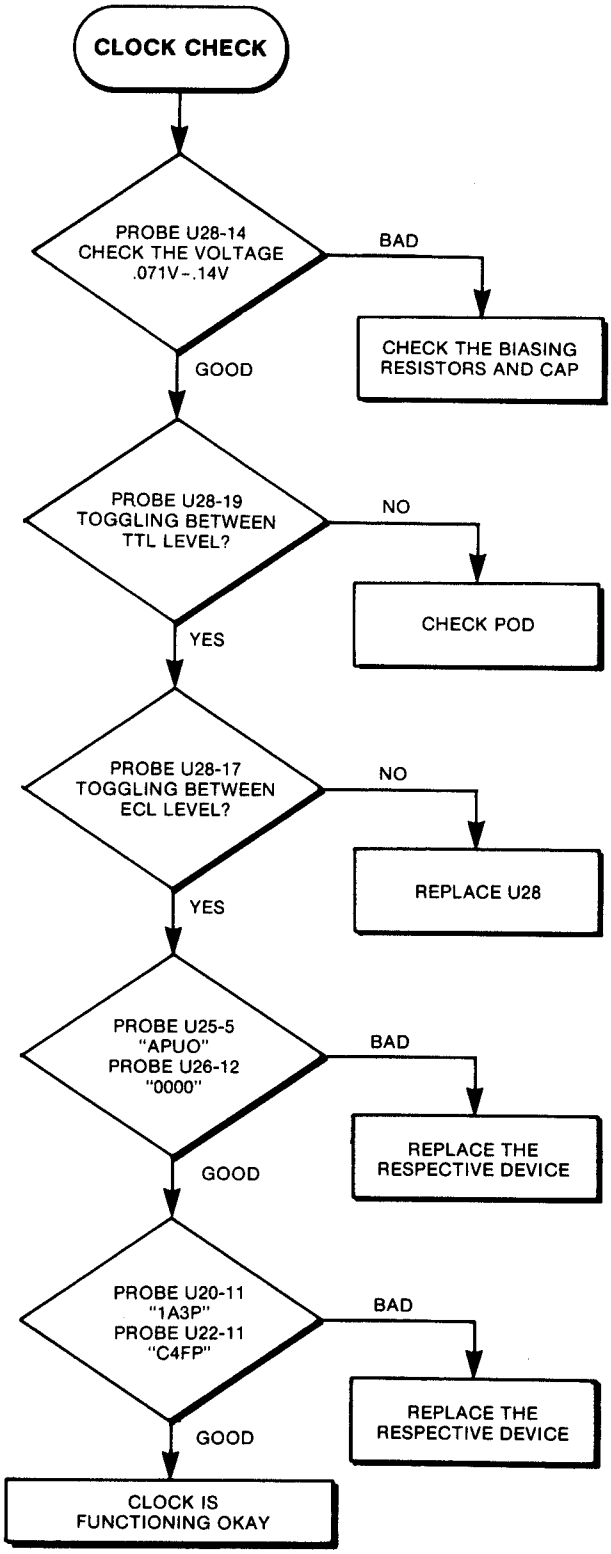


Figure 8-16. Troubleshooting Flowchart Clock Check

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

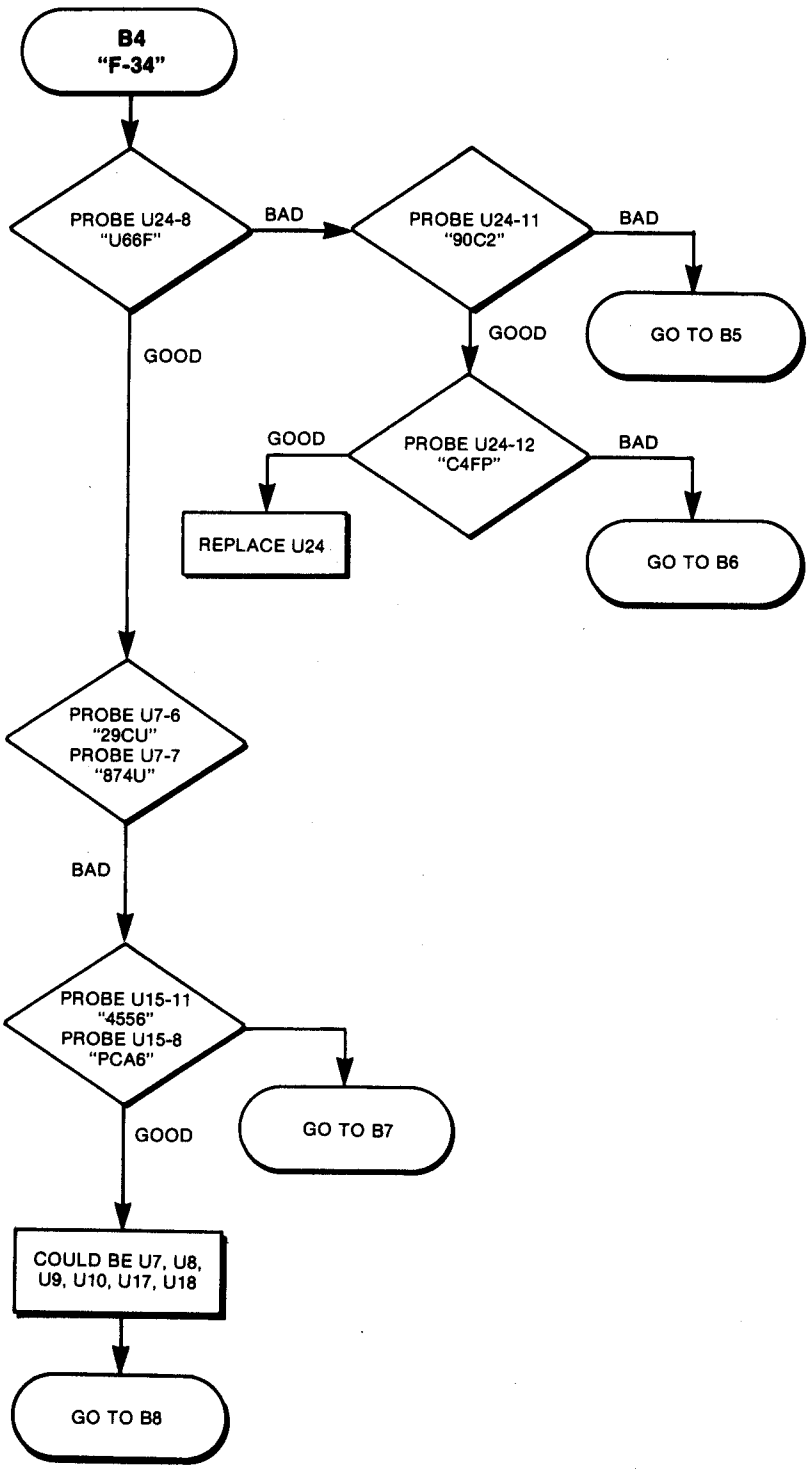


Figure 8-17. Troubleshooting Flowchart B4

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

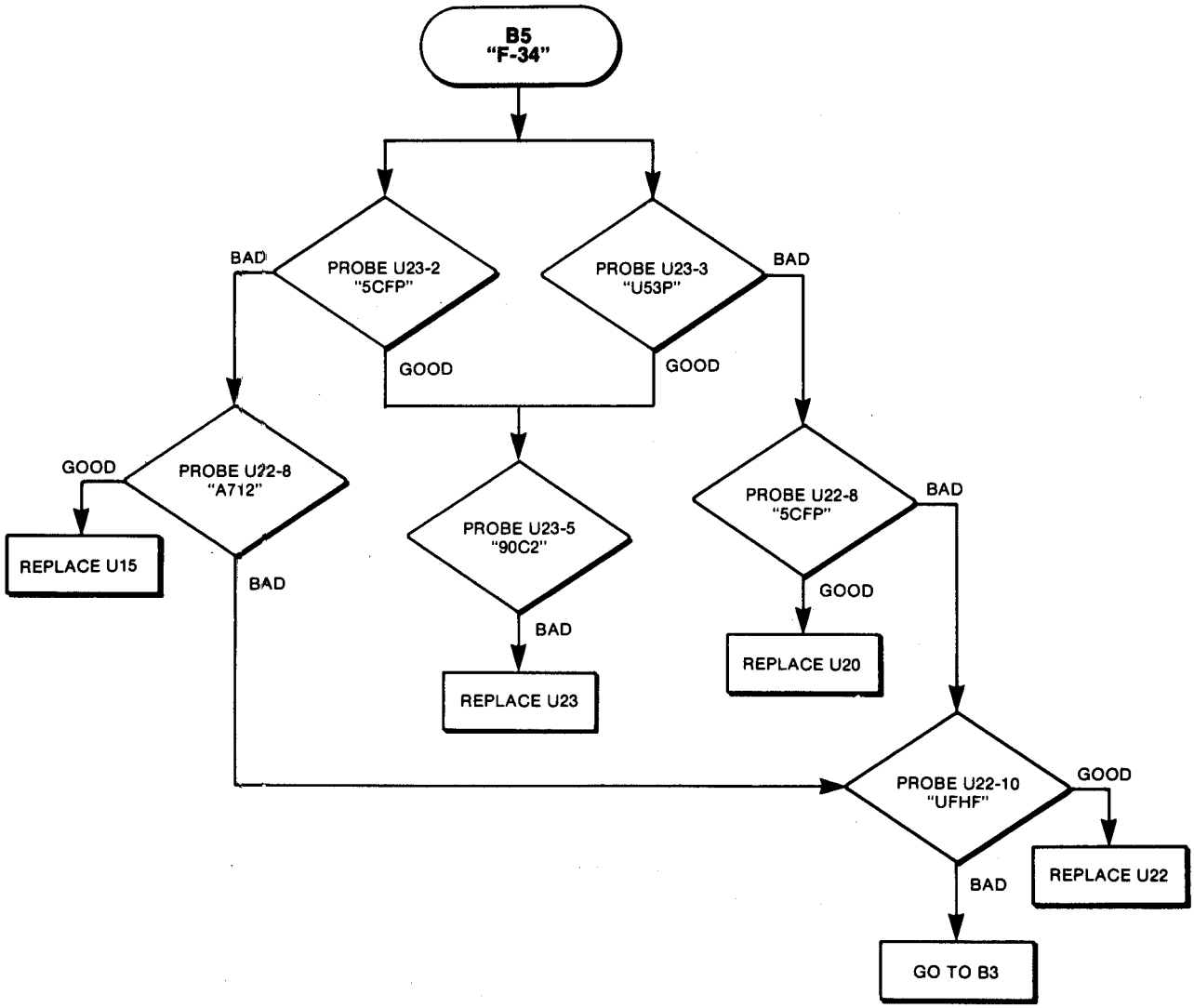


Figure 8-18. Troubleshooting Flowchart B5

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

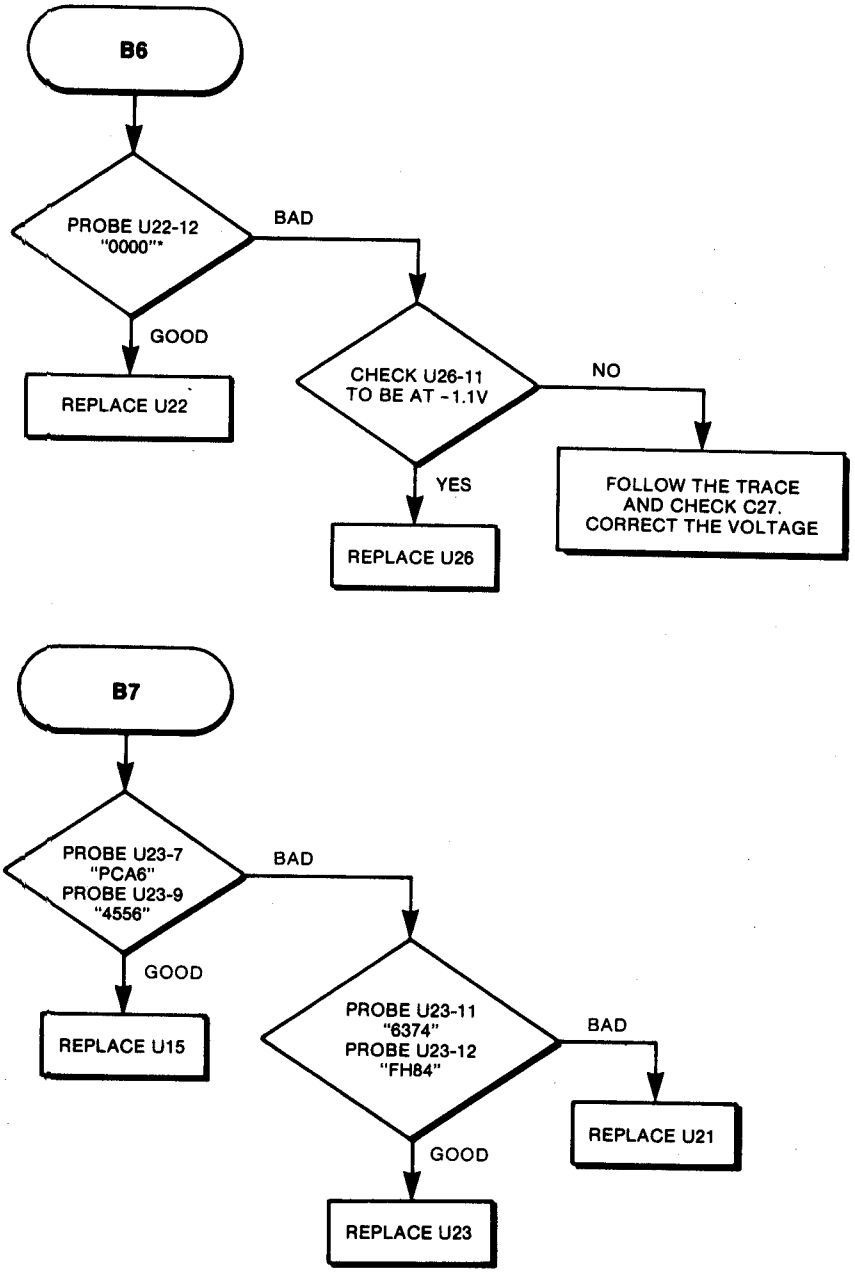


Figure 8-19. Troubleshooting Flowchart B6 and B7

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

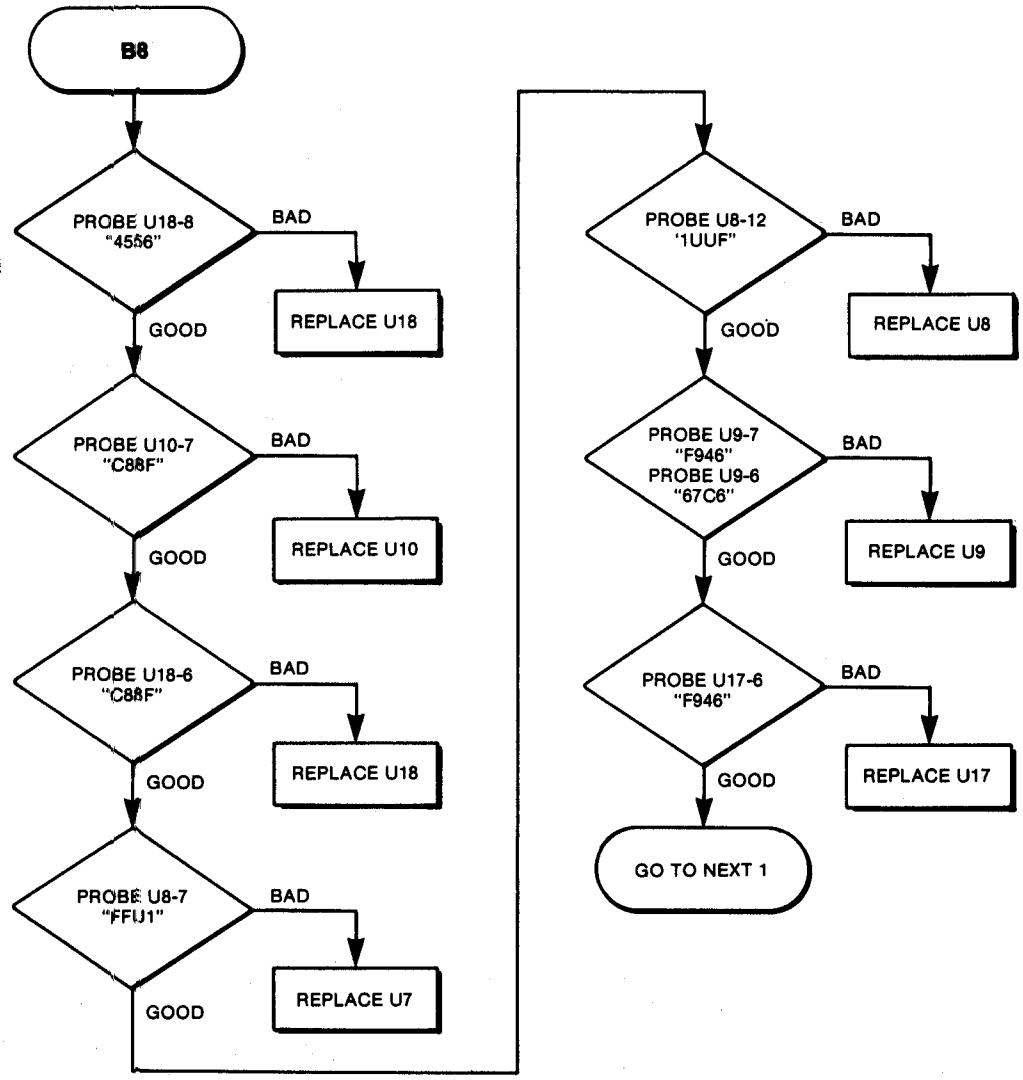


Figure 8-20. Troubleshooting Flowchart B8

SET-UP FOR TAKING SIGNATURES

CONNECT THE POD AND PROBE TO THE FRONT PANEL. SWITCH THE SERV/NORM SWITCH TO THE SERVICE POSITION. THE DISPLAY WILL SHOW "F-32" WHICH IS NORMAL WHEN THE SERV/NORM SWITCH IS IN THE SERV POSITION. TAKE ANOTHER SIGNATURE ANALYZER AND PLUG IT'S CLK, ST, SP AND GND LINES TO THE RESPECTIVE PINS ON THE MOTHERBOARD. NOW YOU ARE READY TO TAKE SIGNATURES. CHECK VCC SIGNATURE TO VERIFY CONNECTIONS.

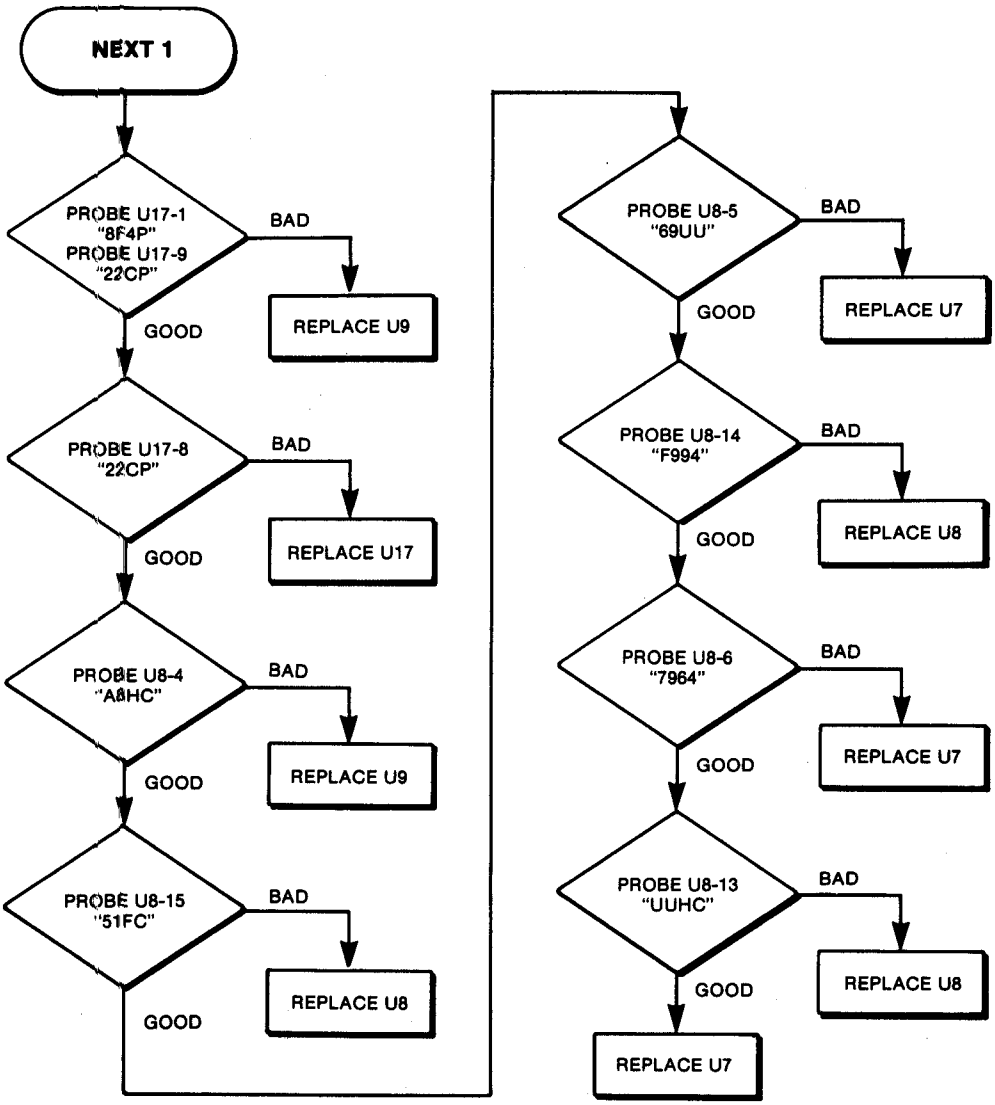
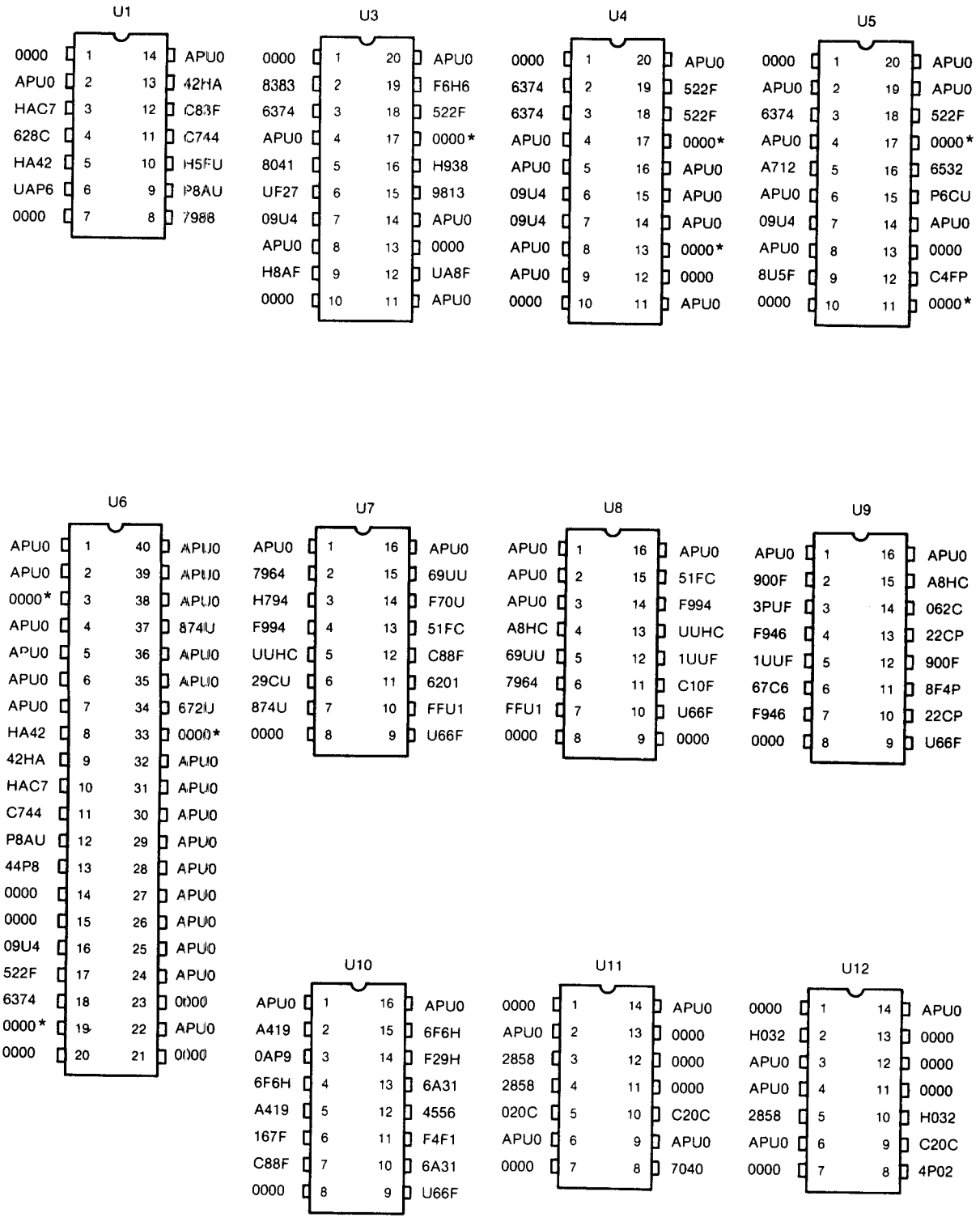
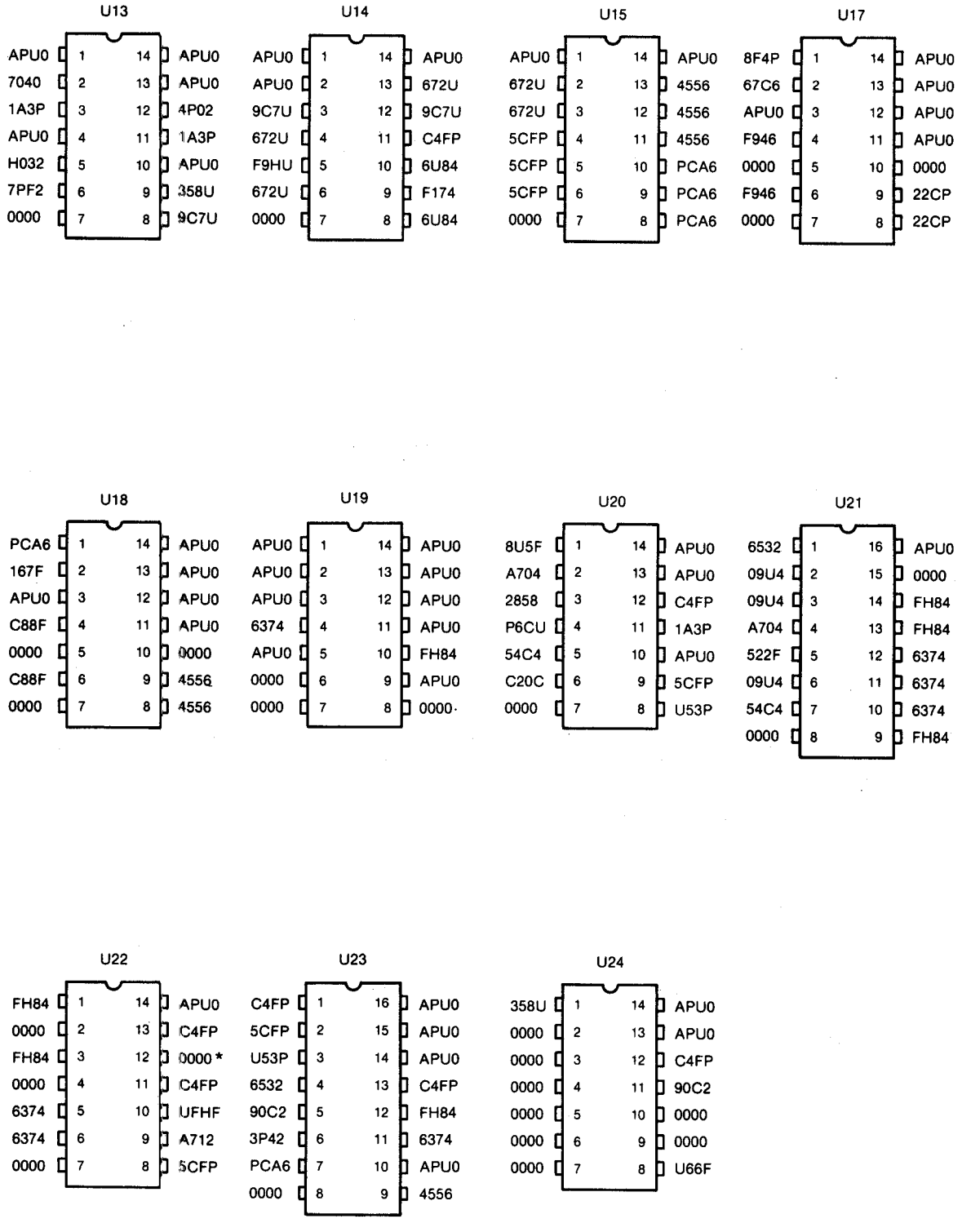


Figure 8-21. Troubleshooting Flowchart Next 1



*Activity present on this line even though the signature is 0000.

Figure 8-22. Signature Table



*Activity present on this line even though the signature is 0000.

Figure 8-22. Signature Table (Continued)

Table 8-3. Error and Failure Message Response during Troubleshooting

	Numbered Error and Failure Messages	Recommended Action
	Operator EDIT Errors	Press CLEAR Key
Er01	Attempted EDIT with no signatures in memory	
Er02	Attempted EDIT of COMPOSITE SIGNATURE	
	Interface Command/Protocol Errors	
Er50	Unrecognized command	
Er51	Illegal numeric parameter	
Er52	Illegal character in command	
Er55	HP-IL loop protocol error	
	External Interface Connection Error	
Er70	Controller connected to talk-only instrument	
	Microcomputer Failures	
		Replace:
F-10	ROM failure	A1U6
F-11	Working RAM failure	A1U6
F-12	Signature memory RAM failure	A1U6
F-13	Timer failure	A1U6
	Microcomputer to Main Board Connection Failures	
		Check:
F-20	Data bus latch failure	A1U3,U4,U5
F-21	Data bus latch enable failure	A1U4,U5
F-22	Digit driver failure	A1U1,Connector
F-23	Input port failure	A1U7, U14
F-24	Nonexistent key failure	A1U1, Keyboard
	Main Board Failures	
		Check:
F-30	Data probe does not recognize lows	U19,22,26,28,DP
F-31	Data probe does not recognize highs	U19,22,26,28,DP
F-32	Measurement gate failure, closed when should be open	U14
F-33	Measurement gate failure, open when should be closed	U11,12,13,14,TP
F-34	Incorrect signature	U7,8,9,10,17,18
	Main Board to Interface Connection Failures	
		Run Service Loop, Check:
F-40	Interface power-up failure	U6
F-41	Interface timeout on input	U6
F-42	Interface timeout on output	U6
	Interface Microprocessor Failures	
		Replace:
F-60	ROM failure	A5U5/A4U5
F-61	RAM failure	A5U5/A4U5

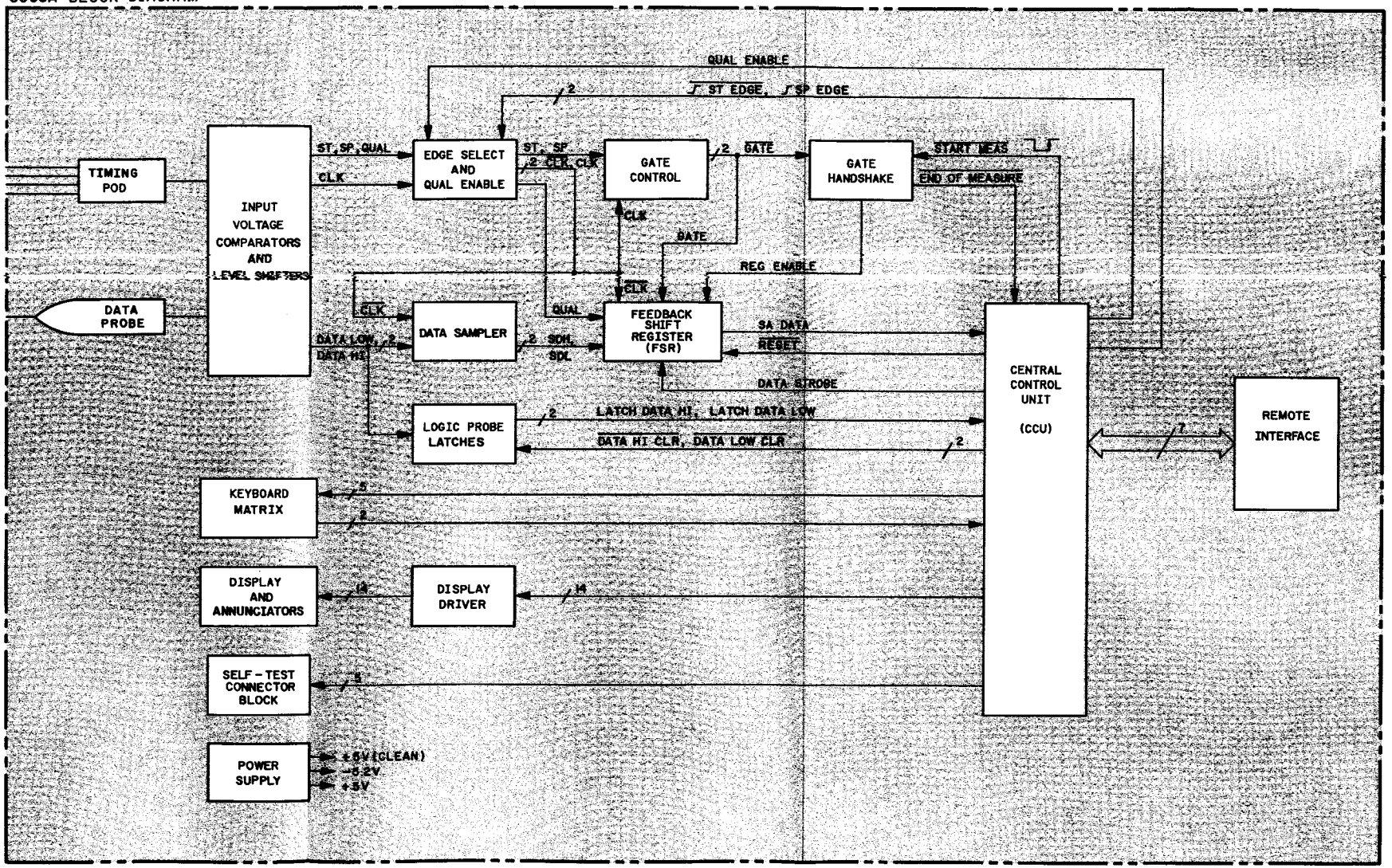
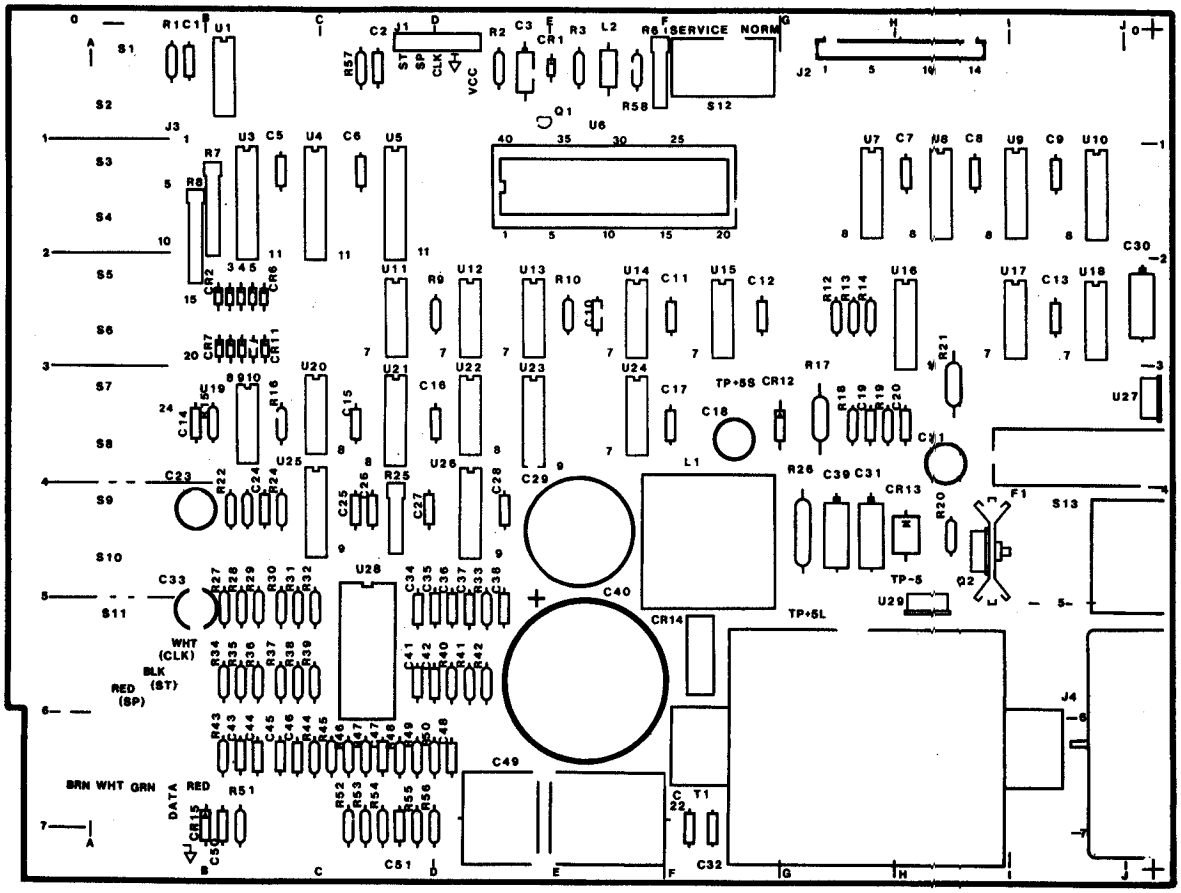


Figure 8-23. Block Diagram



A1

Part of Figure 8-24. A1 Main Assembly Component Locator

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES

3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

4. THE SYMBOL ▽ INDICATES THE ANALOG CIRCUIT COMMON. THE SYMBOL ▽D INDICATES THE DIGITAL CIRCUIT COMMON.

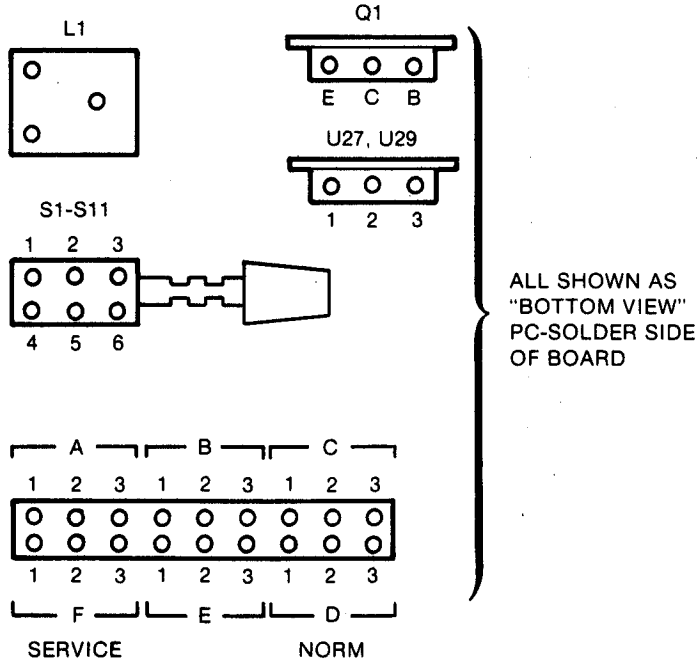
A1 REFERENCE DESIGNATORS

C1-C51
CR1-CR15
Q1, Q2
L1, L2
R1-R57
S1-S12
U1, U3-U28
T1
J1-J4

A1 ACTIVE COMPONENTS

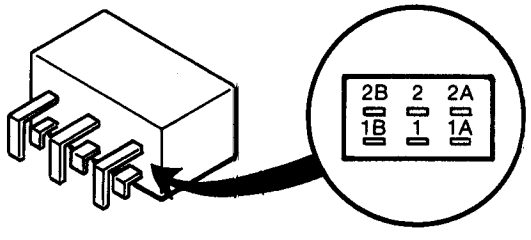
REFERENCE DESIGNATION	HP PART NO.
CR1-CR11	1901-0050
CR12	1902-0522
CR13	1901-0782
CR14	1906-0096
CR15	1902-0175
Q1	1854-0215
Q2	1853-0363
U1	1820-1200
U2	NOT ASSIGNED
U3	1820-2641
U4	1820-2641
U5	1820-2641
U6	1820-3427
U7	1820-2696
U8	1820-1303
U9	1820-2696
U10	1820-2696
U11	1820-2676
U12	1820-2676
U13	1820-2691
U14	1820-2691
U15	1820-2686
U16	1826-0565
U17	1820-1158
U18	1820-1158
U19	1820-2691
U20	1820-2692
U21	1820-1015
U22	1820-2692
U23	1820-2992
U24	1820-2676
U25	1820-1052
U26	1820-1052
U27	1826-0215
U28	1826-0630
U29	1826-0122

MARGIN SCHEMATIC NOTES



ALL SHOWN AS "BOTTOM VIEW" PC-SOLDER SIDE OF BOARD

S13
VOLTAGE SELECT SWITCH



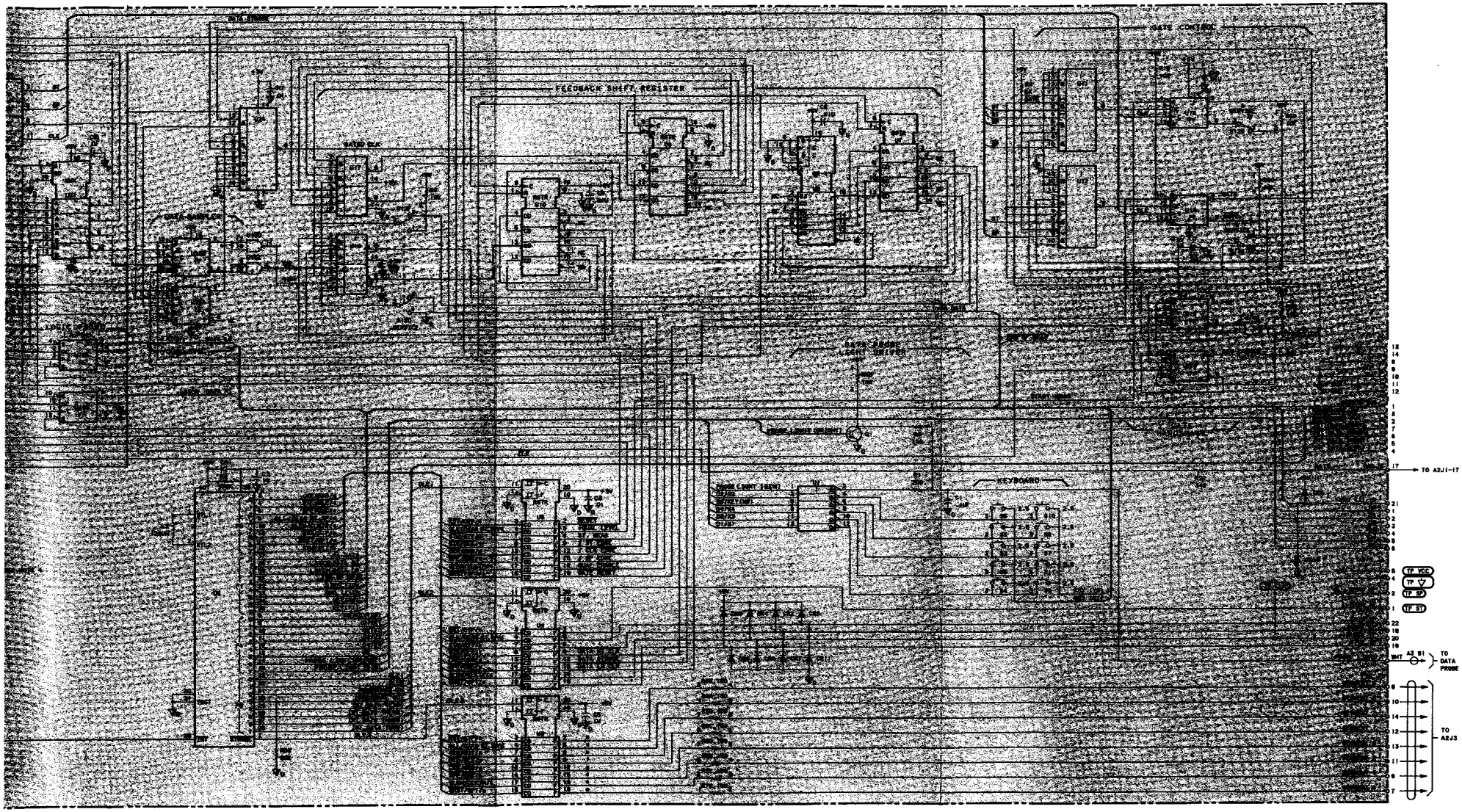
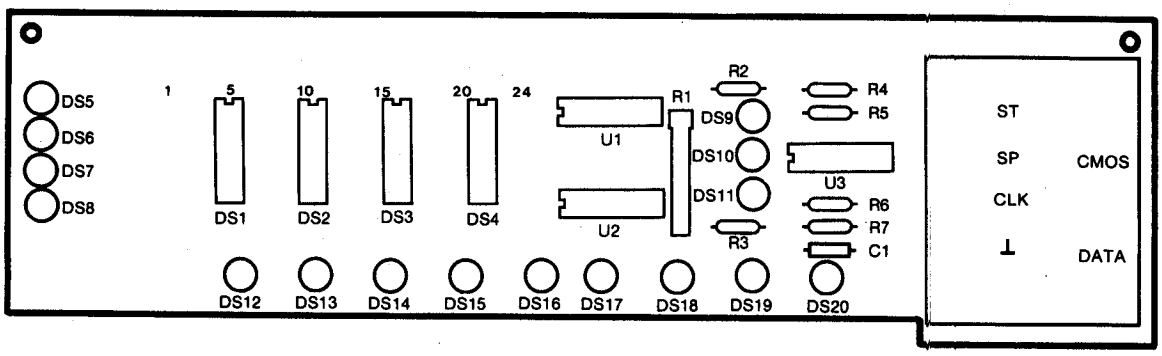


Figure 8-24. A1 Main Assembly Schematic Diagram



A2

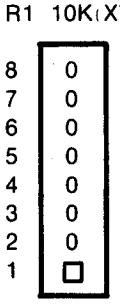
Part of Figure 8-25. A2 Display Assembly Component Locator

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES

3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

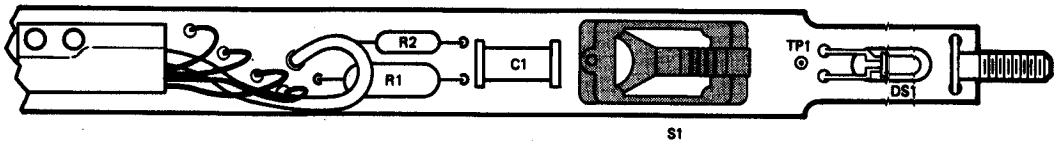


A2
REFERENCE
DESIGNATORS

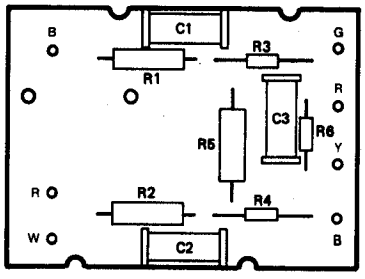
U1-U3
R1-R7
DS1-DS20
J1

A2 TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATION	HP PART NO.
DS1-DS4	1990-0574
DS5-DS20	1990-0547
U1, U2	1858-0076
U3	1820-1200



A3



A6

Part of Figure 8-26. A3 Data Probe Assembly Component Locator and A6 Pod Timing Assembly Component Locator